ME 174

Operating and Maintenance Handbook

MARCONI INSTRUMENTS LIMITED, ENGLAND

F.M. SIGNAL GENERATOR

TYPE TF 1066A

MP MASTER

MA31183

OPERATING AND MAINTENANCE

HANDBOOK

for

F.M. SIGNAL GENERATOR

TYPE TF 1066A

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SCHEDULE OF PARTS SUPPLIED

The complete equipment comprises the following items:-

1. One F. M. Signal Generator Type TF 1066A complete with attached mains lead and valves etc. as under:-

Valves:	One:	Type 5Z4G, Full-Wave Rectifier.
	One:	Type 6AK6, Pentode.
	One:	Type TDO3-10 Disk-Seal Triode.
	One:	Type 6AK5 (EF95), Pentode.
	One:	Type 6C4 (L77), Triode.
	One:	Type 12AX7, Double Triode.
	One:	Type 6L6G (KT66), Tetrode.
	One:	Type 6CD6G, Tetrode.
	One:	Type OB2 (QS1208), Voltage Stabilizer.
	One:	Type 85A2, Voltage Stabilizer.
	Two:	Type XB1, Barretters.
Semiconductors:	One:	Type CS2A, Silicon Diode.
	Two:	Type CG1E, Germanium Diodes.
Fuses:	One:	0.25-amp, Cartridge.
	Two:	2.0-amp, Cartridge.
Lamp:	One:	6.3-volt, 0.15-amp, M. B. C. Pilot Lamp.

2. One Coaxial Free Plug, Type N, 50 Ω, for R.F. Output socket.

3. One CORRECTION CHART FOR DEVIATION AND INCREMENTAL FREQUENCY MONITOR - card to TC 25688, normally stowed in left-hand case-handle recess.

4. One Operation and Maintenance Handbook No. OM 1066A.

The following output accessories are optional items supplied only if specially ordered.

5. Output Lead, 50-ohm, Type TM 4824.

6. 20-dB Pad, 50-ohm, Type TM 4919.

7. 6-dB Pad, 50-ohm, Type TM 4919/1.

Schedule of Parts Supplied (continued)

8. Matching Unit, 50 ohm to 75 ohm, Type TM 4918.

9. Matching Unit, 50 ohm Unbalanced to 300 ohm Balanced, Type TM 4916.

10. D.C. Isolating Unit Type TM 4917.

1. DESCRIPTION

1.1. GENERAL

The Marconi TF 1066A Signal Generator covers the carrier-frequency range 10 to 470 Mc/s. The primary purpose of the instrument is to provide c.w. or frequency-modulated outputs, but amplitude-modulated outputs can also be obtained. The open-circuit voltage is continuously variable from 0.2 μV to 200 mV; and the output impedance is 50 ohms.

Illustration No. MP 1066A-1 at the end of the manual shows the layout of the front panel of the instrument. This may be of guidance to the reader for identification of the panel controls etc. referred to in the following text.

Tuning and Incremental Frequency Controls. The frequency range is covered in five bands; each band has its own directly calibrated scale on the main tuning dial.

For general tuning there are two controls. One is the normal or COARSE TUNING control linked to the main tuning dial, and the other is an uncalibrated FINE TUNING control, which has a total cover of the order of 25 kc/s.

For bandwidth measurements etc., there is a continuously variable INCremental FREQuency control and also an INCremental FREQuency switch.

The continuously variable control enables the operator to make small known changes in the carrier frequency. The magnitudes of these changes are indicated directly on the appropriate scales of the MODULATION AND INCREMENTAL FREQUENCY meter. This meter has two incremental scales selected by means of a switch. One scale is calibrated at 10-kc/s intervals from -100 kc/s to +100 kc/s, and the other is calibrated at 2-kc/s intervals from -20 kc/s to + 20 kc/s.

By the use of the INCremental FREQuency switch the carrier frequency can be shifted by 5, 10 or 15 kc/s in either direction. When the switch is in use the meter and the continuously-variable control become inoperative.

Modulation. Frequency modulation can be applied at any deviation up to 100 kc/s. A built-in a.f. oscillator provides the internal modulating signal. The frequency of this oscillator is 1 kc/s or 5 kc/s depending upon the setting of a selector switch. External f.m. can be applied at any frequency

1.1. (continued)

between 30 c/s and 15 kc/s. For both internal and external modulation, the deviation is indicated directly in kc/s on the modulation scales of the MODULATION AND INCREMENTAL FREQUENCY meter.

Amplitude modulation can be applied at any depth up to at least 40% from the same sources - both internal and external - as for f.m. The modulation depth is indicated on the MODULATION AND INCREMENTAL FREQUENCY meter; the same scales are used for a.m. depth as for f.m. deviation. These scales are calibrated 0-20 and 0-100 respectively, the sensitivity being selected by means of a switch.

R.F. Output Level. The r.f. output level of the Signal Generator is adjusted by means of a 50-ohm piston attenuator. The setting of the attenuator is indicated on a $4\frac{1}{2}$-inch dial having two scales - one calibrated directly in units of voltage and the other in decibels relative to 1 μV.

The cursor fitted to the attenuator dial is reversible. With one face of the cursor exposed, the hairlines indicate the source e.m.f. When the cursor is turned over, the indication is in terms of p.d. developed across a 50-ohm load.

1.2. DESIGN DETAILS

The general arrangement of the electrical circuits is shown on the Functional Diagram, Drawing No. TLC 28312; the complete Circuit Diagram of the r.f. unit is given on Drawing No. TLC 28313 and of the l.f. and power unit on Drawing No. TLC 28314. Component values are given in the Spares Ordering Schedule No. SOS/1066A. These diagrams and the schedule are included in the Appendices at the end of this manual.

Reference to these diagrams should assist the reader in fully understanding the principles described in this section.

1.2.1. The R.F. Unit.

Generating at the output frequency without the use of multipliers, the r.f. oscillator employs a disk-seal triode (V6) in a form of shunt-fed Colpitts circuit. The split-stator tuning capacitor is specially designed to have a low residual inductance. The stator plates are triangular and the two stator sections are arranged to mesh with a single set of rotor plates.

1.2.1. (continued)

There is a two-section set of stator plates for each of the five frequency bands; and the two sections of each set are linked by the appropriate tuning inductor, which is permanently attached to them.

The five stator-plate/tuning-inductor assemblies are mounted in a turret which is rotated by operation of the band-selector (RANGE) control. This turret is mounted coaxially with the capacitor-rotor spindle so that the rotor plates mesh with each set of stator plates in turn. The active stator assembly for the selected band is connected to the oscillator valve by a pair of coupling capacitors. These capacitors are formed by extensions of the stator plates meshing with truly fixed plates rigidly secured to the frame of the r.f. unit.

The tuning-capacitor rotor is coupled mechanically to the main tuning dial by means of a one-to-one gear train and to the tuning control on the front panel by means of a 55:1 reduction gear. The gear system is spring-loaded throughout to reduce backlash to a minimum.

The level of output from the r.f. oscillator is monitored by a silicon-diode voltmeter (MR2 and M1) inductively coupled to the oscillatory circuit. When the Signal Generator is in use, the output of the oscillator is set up to a reference level - as indicated by a calibration mark on the meter scale - by means of the SET CARRIER control (RV6) which varies the oscillator h.t. voltage.

The piston attenuator is of the mutual-inductance type, and its pick-up element is fitted with a resistance-capacitance network which keeps the output impedance sensibly constant at 50 ohms despite change in frequency. A 50-ohm Type N plug is normally supplied with the instrument; and there are also a number of optional output-accessories available, listed in the Schedule of Parts Supplied.

The piston attenuator is coupled to its indicator dial by a rack-and-pinion drive mechanism. Like the main tuning drive, the attenuator-drive mechanism is spring loaded to reduce backlash. The panel control operates through a friction-type slow-motion drive.

1.2.2. Modulation.

The internal modulating signal is derived from a conventional Hartley oscillator utilizing a single triode valve (V7) and a tuned transformer (T2). The modulation-frequency selector (SE) brings into circuit the appropriate

1.2.2. (continued)

tuning capacitor to give either 1 kc/s or 5 kc/s as required. The output level of this oscillator is varied by means of the SET MOD control. This control takes the form of a potentiometer (RV5) connected across the output of the modulation-oscillator circuit.

External modulation is introduced via a pair of terminals on the front panel. The modulating signal - either internal or external - is selected by means of switch SC. The setting of this selector switch also determines whether the signal is applied to the amplitude- or frequency-modulating circuit. The switch disconnects the h.t. of the modulating oscillator when set for c.w. or external modulation.

Frequency modulation is effected by the use of a ferrite frequency-modulator (TR1). In this type of modulator the inductance of a small r.f. coil is varied by permiability changes in its ferrite core. This core completes the magnetic circuit of an l.f. inductor whose winding carries the a.f. modulating current. The ferrite core is magnetically biased to a non-linear part of its B/H characteristic. Therefore, variations in the magnetic field strength, due to the a.f. modulating current, cause corresponding changes in the permiability of the ferrite core.

The a.f. modulating current is fed to the l.f. winding of the modulator via a pentode driver valve (V2).

For a constant f.m. deviation, the necessary magnitude of the modulator's reactance swing varies inversely with carrier frequency. Or, in other words, the required level of a.f. drive to the modulator is not constant but decreases when the Signal Generator's output frequency is increased. It is desirable, however, that the level of a.f. input to the overall modulating system should remain constant. The modulating signal, therefore, is fed to the grid of the driver valve (V2) via a correcting network which is varied by both the main tuning control and the frequency-band selector switch.

The carrier is amplitude modulated by direct anode modulation of the r.f. oscillator. The modulating signal is applied via an amplifier valve (V8), the SET CARRIER control (RV6), and an r.f. filter to the anode of the oscillator valve (V6).

Secs. 1, 2, 2. (continued)

1.2.3. Fine Tuning and Incremental Frequency Controls.

The FINE TUNING control is a variable resistor (RV9) in series with the h.t. feed to the modulator-driver valve (V2). Adjustments to the control produce variations in the anode and screen-grid voltages of V2, and thus alter the standing current in the l.f. winding of the ferrite modulator. This action, of course, alters the carrier frequency of the oscillator.

The INCremental FREQuency controls - i.e., the switch and the continuously variable control - also vary the standing current in the l.f. winding of the modulator. However, in this case, the effect is produced by varying the level of a d.c. voltage applied to the correcting network in the grid circuit of the driver valve (V2).

The INC FREQ switch (SF) has eight positions: viz., a central zero position, +5, +10, and +15, -5, -10, and -15, and a position engraved VAR. In the normal operating positions of the switch, the meter and the continuously-variable control are out of circuit.

The shift voltages are derived from a close-tolerance stepped potentiometer system (R60 to R69), the appropriate tapping for the required shift being selected by the INC FREQ switch.

When the INC FREQ switch is set to VAR the stepped potentiometer is switched out of circuit, and the d.c. voltage is adjusted by means of the continuously variable control (RV1). The voltage is monitored by the MODULATION AND INCREMENTAL FREQUENCY meter, and indicated on a scale calibrated directly in kc/s of frequency shift.

1.2.4. Modulation and Incremental Frequency Monitor.

The MODULATION AND INCREMENTAL FREQUENCY meter is used for monitoring the f.m. deviation, the incremental frequency shift, and also the a.m. depth. The setting of the monitor-selector switch (SD) determines whether the meter shall indicate the amount of modulation or incremental-frequency shift. This switch can also be set to give a choice of two sensitivities for either of these functions.

When the meter is used for monitoring incremental shift, it acts as a simple d.c. voltmeter connected between the slider of the continuously-variable incremental frequency control and chassis.

1.2.4. (continued)

The operation of the modulation monitoring system can be most easily understood by considering the amplitude-modulation monitor first. When the carrier is amplitude modulated, the r.f. monitoring detector (MR2) produces an output which contains an a.f. component in addition to the d.c. component that produces the deflection of the CARRIER LEVEL meter pointer. This a.f. component is fed via a d.c. blocking capacitor (C16) to the grid of the first triode section of double-triode valve V9. This first section is connected as a simple R-C coupled amplifier; and the output of this amplifier is fed to the second triode section, which is wired as a cathode follower. The output from the cathode follower is rectified by germanium diodes MR3 and MR4 and passed to the monitoring meter (M2). Diodes MR3 and MR4 are connected in the form of a voltage-doubler circuit; this arrangement gives an improved scale linearity and better sensitivity than a single-diode detector.

When the Signal Generator is set for frequency modulation, the grid of the cathode-follower section of V9 is disconnected from the R-C amplifier by the action of the modulation-selector switch (SC); and it is then coupled to the input of the correcting network to the modulator-driver valve (V2). In this way the level of the audio-frequency signal applied to the network is monitored. The correcting network is automatically adjusted to keep the ratio of a.f. input voltage to f.m. deviation constant at all carrier frequencies. The meter, therefore, gives a correct reading of f.m. deviation at all settings of the tuning controls.

1.2.5. Power Supply Unit

The mains transformer (T1), which forms part of the built-in power unit, has a primary winding composed of two tapped sections. These sections can be connected in series or series-parallel to facilitate the operation of the instrument from a ~~selection of supply voltages in the ranges~~ 180 to 250 volts and 100 to 150 volts a.c. Full details of the methods of adjusting the power unit to suit different supply voltages and either 40- to 60-c/s or 500-c/s supply frequencies are given in Section 4.

The main h.t. supply is derived from a low-impedance series-stabilizer circuit comprising valves V3 and V4 with a reference potential controlled by the gas-filled stabilizer V5. The input for this circuit is drawn, via a full-wave rectifier (V1), from a centre-tapped h.t. winding on the mains transformer. A negative reference voltage for the incremental frequency controls is obtained by a voltage-doubler type of rectifier (MR1),

1.2.5. (continued)

the a.c. being drawn from the h.t. secondary winding of the mains transformer. The use of such a circuit permits the inclusion of a reactive voltage dropper (capacitor C47). Thus the reference voltage is reduced to the correct value without the use of a dropping resistor, which would dissipate power and produce additional undesirable heating. The reference voltage is regulated by means of a gas-filled stabilizer (V 10).

The heater supplies to the r.f. oscillator and modulator-driver valves (V 6 and V 2) are drawn from a 24-volt winding on the mains transformer and stabilized by a pair of barretters (V 11 and V 12) which also reduce the voltage applied to the valves to 6.5 volts. The heater supplies to the other valves in the instrument are drawn directly from two 6.3-volt windings and a single 5-volt winding on the mains transformer.

2. OPERATION

NOTE: Location of Controls is shown on MP 1066A - 1 at the end of the manual.

2.1. INSTALLATION

Signal Generator Type TF 1066A can be adjusted for operation from any 40-c/s to 60-c/s mains supply or 500-c/s mains supply in the voltage ranges 100 to 150 volts and 180 to 250 volts.

Full instructions for adjusting the internal power unit to suit the local supply are given in Section 4.3.

Unless otherwise specified, the Signal Generator is normally despatched ready for immediate operation from 240-volt, 40-c/s to 60-c/s supplies.

2.2. SWITCHING ON AND WARMING UP

Be sure that the instrument is correctly adjusted to suit the particular mains supply to which it is to be connected. Then proceed as follows:-

(1) Connect the mains lead to a supply socket. The lead is permanently attached to the instrument and is stowed in the left-hand case-handle recess.

(2) Switch ON by means of the SUPPLY switch. The red pilot lamp should now glow.

Before proceeding further, wait two or three minutes for the valves and internal circuits to warm up. If a very high order of stability is required, extend this period to approximately half an hour.

2.3. TUNING

The Signal Generator covers its carrier range in five bands:-

10 to 22 Mc/s
22 to 48 Mc/s
48 to 110 Mc/s
110 to 240 Mc/s
240 to 470 Mc/s

2.3. (continued)

The tuning facilities are as follows:-

(1) The output signal can be set by means of the COARSE TUNING control to any predetermined frequency as read directly from the main tuning dial (see Section 2.3.1).

(2) The FINE TUNING control enables the operator to tune the Signal Generator precisely to a desired point on the response characteristic of the equipment under test (see Section 2.3.1).

(3) The continuously variable incremental-frequency control can be used for shifting the carrier frequency by known amounts up to 100 kc/s in either direction (see Section 2.3.2).

(4) The INCremental FREQuency switch may be used for shifting the carrier frequency in steps of 5 kc/s to a maximum shift of 15 kc/s in either direction (see Section 2.3.3).

(5) Incremental Frequency shifts can be produced by means of an external circuit coupled to the external modulation f.m. terminals. This facility can be used for the production of stepped carrier shifts of up to 100 kc/s in either direction (see Section 2.3.4).

2.3.1. General Procedure

To tune the Signal Generator to a particular frequency proceed as follows:-

(1) Set the INC FREQ switch to its central 'zero' position, and the FINE TUNING control to mid travel.

(2) Select the required frequency band by means of the RANGE control. To change from one band to another rotate the control through one-and-a-fifth turns per band until it locates positively with the knob pointing to the required frequency band.

(3) By means of the COARSE TUNING control, tune the Signal Generator to the required carrier frequency as indicated on the main tuning dial. Using the hairline on the transparent cursor, read the frequency on the calibration arc appropriate to the band selected in (2) above.

2.3.1. (continued)

Fine Tuning. To tune the Signal Generator precisely to a particular point on the characteristic of a tuned system under test (e.g. to peak the tuning to the centre frequency of a receiver's response) proceed as follows:-

(1) Use the COARSE TUNING control to bring the signal frequency as near to the required point as possible.

(2) Make the final adjustment with the FINE TUNING control. The total cover of this control is of the order of 25 kc/s.

2.3.2. The Continuously Variable Incremental-Frequency Control

(1) Set the INC FREQ switch to VAR and the monitor-selector switch to INC FREQ 20 kc/s.

(2) Adjust the continuously variable incremental-frequency control to bring the pointer of the MODULATION AND INCREMENTAL FREQUENCY meter to the centre-zero mark on the lowest scale of the dial.

(3) Use the COARSE TUNING control to tune the Signal Generator to the approximate centre frequency of the equipment under test, and set up for c.w. or a.m. as described in Sections 2.4.1. and 2.4.3. Response or bandwidth measurements are not normally made with a frequency-modulated signal.

(4) If, in (3) above, the monitor-selector switch has been turned to a MOD position, restore it to one of its INC FREQ positions - either 20 kc/s or 100 kc/s depending on the range over which the incremental frequency variations are to be made.

(5) Use the COARSE and FINE TUNING controls to tune the Signal Generator accurately to the centre frequency of the equipment under test.

2.3.2. (continued)

(6) Adjust the continuously variable incremental-frequency control to produce the required change in carrier frequency. Read the change in frequency directly from the appropriate scale of the MODULATION AND INCREMENTAL FREQUENCY meter. The incremental scales are easily identified being marked in red on the lowest arc of the meter dial. If necessary, apply the correction for accuracy - see under.

Accuracy of Incremental-Frequency Meter. For carrier frequencies between 10 and 240 Mc/s, the meter indicator is accurate to within 10% of full scale for all values of shift up to the maximum of 100 kc/s.

Above 240 Mc/s the accuracy of the meter indication falls off to 20%, but an accuracy of 10% of full scale can be obtained by applying the correction given by the black curve on the CORRECTION CHART FOR DEVIATION AND INCREMENTAL FREQUENCY MONITOR. This chart is in the form of a card and is normally stowed in the left-hand case-handle recess.

2.3.3. The Stepped Incremental-Frequency Switch

(1) Set the INC FREQ switch to its zero position.

(2) Use the COARSE TUNING control to tune the Signal Generator to the approximate centre frequency of the equipment under test; and set up for c.w. or a.m. as described in Sections 2.4.1. and 2.4.3.

(3) Tune the Signal Generator accurately to the centre frequency of the equipment under test using the COARSE and FINE TUNING controls.

(4) Use the INC FREQ switch to shift the carrier frequency in steps of 5 kc/s in either direction as required.

NOTE: ~~The Incremental-Frequency monitor is inoperative when~~ the INC FREQ switch is set to any position other than VAR.

2.3.3. (continued)

Accuracy of Incremental-Frequency Steps. At carrier frequencies below 240 Mc/s, frequency changes made with the INC FREQ switch are accurate to within 10% of the value indicated by the switch setting.

Above 240 Mc/s, the accuracy falls to 20%.

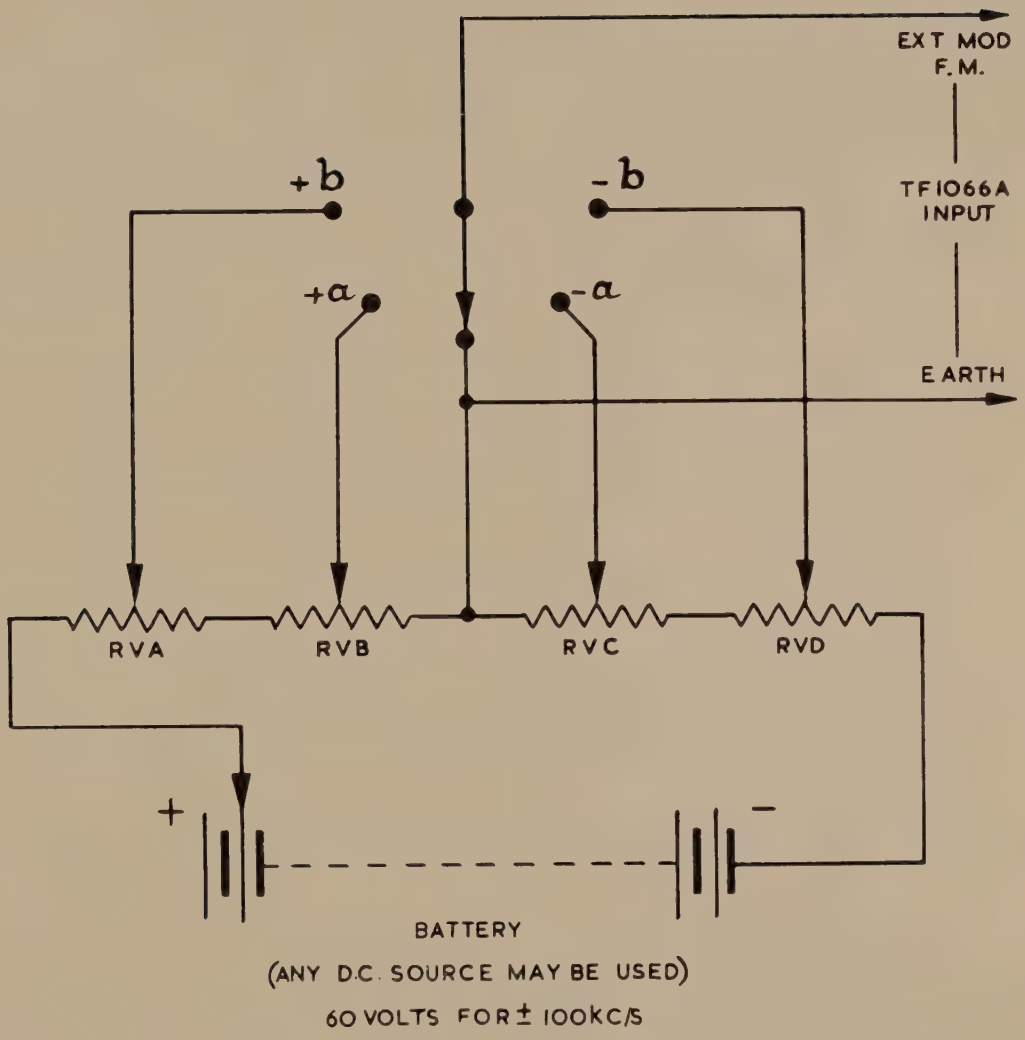
The CORRECTION CHART supplied with the Signal Generator is primarily for use with the Deviation and Incremental Frequency Monitor. Although this monitor is out of use when frequency changes are made with the INC FREQ switch, the chart can, nevertheless, be utilized. By means of the chart, the actual frequency changes introduced at various settings of the INC FREQ switch can be determined to within 10% at all carrier frequencies. The following example illustrates the use of the chart for this purpose.

Example: The chart supplied with a representative TF 1066A showed that, at 340 Mc/s, a correction of approximately -10% should be applied to deviation and incremental frequency readings on the monitor meter. Applying this figure of -10% to the 5, 10, and 15 kc/s positions on the INC FREQ switch showed that, at 340 Mc/s, the actual frequency changes introduced were 4.5, 9, and 13.5 kc/s respectively.

WARNING: Inaccuracies due to external circuits. If the circuit of any apparatus connected to the EXT MOD F.M. and earth terminals offers a d.c. path, the potentiometer network controlled by the INC FREQ switch will be shunted and the accuracy of the incremental frequency steps will be affected. This may be avoided by the insertion of a capacitor in the lead used to make connection to the EXT MOD F.M. terminal.

2.3.4. Frequency Shift From an External Source

Incremental frequency shifts can be produced by the application of an external d.c. voltage between the EXT MOD F.M. and earth terminals when the INC FREQ switch is set to VAR. This may be useful for the production of stepped frequency shifts if the desired steps are different from 5 kc/s or if the desired maximum shift is greater than 15 kc/s.



EXTERNAL INCREMENTAL-SHIFT CIRCUIT

2.3.4. (continued)

Drawing No. TLB 28306, following this page, shows a suitable circuit for connection between the EXT MOD F.M. and earth terminals. This circuit has two positive and two negative frequency-shift settings but may be altered to suit any other requirement. For example, if it is required to have three positive and three negative shift settings, a seven-position switch and six potentiometers are necessary.

The method of setting up the arrangement shown in the diagram is described below. When the circuit is varied to suit some other requirement, the procedure must, of course, be varied accordingly.

(1) Connect the external circuit to the EXT MOD F.M. and earth terminals.

(2) Set the INC FREQ switch to VAR and the continuously variable control to mid travel. Do not move the control again during the test.

(3) Set the monitor-selector switch to INC FREQ 20 or 100 kc/s according to the maximum incremental frequency shift to be used.

(4) Set the five-position switch on the external circuit to position +b and adjust both the external potentiometer RVA and the external d.c. voltage to bring the reading* of the MODULATION AND INCREMENTAL FREQUENCY meter to the larger of the required positive shifts.

(5) Set the five-position switch to position -b, and adjust potentiometer RVD to bring the meter pointer to the larger of the required negative shifts.

(6) If necessary, reset the monitor-selector switch to give a convenient meter sensitivity and, with the five-position switch set to positions +a and -a in turn, adjust potentiometers RVB and RVC respectively to bring the meter pointer to the smaller positive and negative shifts.

(7) Set the five-position switch to its central zero-frequency-shift position. Adjust the Signal Generator to the approximate centre frequency of the equipment under test, and set up for c.w. or a.m. as described in Sections 2.4.1, or 2.4.4. Then accurately tune the Signal Generator to the centre frequency by means of the COARSE and FINE TUNING controls.

* See Section 2.3.2. - Accuracy of Incremental-Frequency Meter.

2.3.5. Modulator Hysteresis

When making incremental-frequency shifts by any of the methods described in the preceding sections, the operator may find some inconsistency of results due to inherent hysteresis in the ferrite modulator.

The effects of this hysteresis are only of significance when the operator makes a frequency shift in a direction different from that previously applied, i.e., when the shift is (i) changed from a positive to a negative value, or vice versa, or (ii) decreased to, or towards, zero. If the shift is increased to a particular value from the true (neutralized) zero, and then further increased, the hysteresis problem does not arise.

Errors due to hysteresis will generally be small - of the order of 5% of the shift - and can be eliminated by "wiping" or neutralizing the magnetic circuit of the modulator before making a reversal of frequency shift. As a point of good practice, this neutralizing should also be carried out before commencing any measurements involving use of the incremental-frequency controls.

To neutralize modulator hysteresis, first, set the incremental shift to zero and apply f.m. to the carrier; then, having set deviation initially to maximum, reduce it slowly to zero. With the modulator now neutralized it may be advisable to check that the Signal Generator is still correctly tuned to the centre frequency of the equipment under test; if necessary, make slight adjustments to the COARSE and/or FINE TUNING controls.

The following example shows the points in a typical sequence of incremental shifts at which it is desirable to neutralize the modulator:

Example: In a receiver response investigation, it is required to shift carrier +50, +75, +100 kc/s; then to drop back in frequency and recheck results at +50 kc/s.

Do this by (i) neutralizing at zero shift; (ii) setting to +50 kc/s; (iii) setting to +75 kc/s; (iv) setting to +100 kc/s; (v) returning to zero and neutralizing again; (vi) setting to +50 kc/s.

2.4. SETTING UP FOR CONTINUOUS WAVE OR MODULATED OUTPUTS

The r.f. output from the Signal Generator can be

(i) Continuous Wave - see Section 2.4.1.
(ii) Frequency Modulated - see Section 2.4.3.
(iii) Amplitude Modulated - see Section 2.4.4.

2.4.1. Continuous Wave

(1) Set the modulation-selector switch to C.W.

(2) Tune to the desired frequency in the manner described earlier in Section 2.3.1.

(3) Turn the ATTENUATOR control to bring the dial to the required setting. (A detailed explanation of the method of setting the r.f. output voltage is given in Section 2.5. R.F. OUTPUT ARRANGEMENTS.)

(4) Adjust the SET CARRIER control to bring the pointer of the CARRIER LEVEL meter to the SET CARRIER mark.

2.4.2. Precautions Against Spurious Modulation

Hum Level Adjustment. For certain types of measurement - such as signal-to-noise ratio of f.m. receivers - it is very important that the spurious f.m. on c.w. shall be as small as possible. This spurious f.m. is mainly caused by hum pick-up from the heaters of the modulator-driver valve (V2) and the r.f. oscillator valve (V6). It can be reduced to very low deviation (less than 100 c/s) by electrically balancing the heaters of these valves with respect to cathode.

A balancing network is therefore included in the heater-supply circuit. The necessary circuit constants in this balancing network vary slightly with temperature and with the output frequency of the Signal Generator. For this reason, part of the balancing network is formed by a variable control (RV3) mounted on the front panel and designated HUM ADJUST.

The method of using the HUM ADJUST control is as follows:-

(1) Connect the TF 1066A to the input of the receiver to be tested.

(2) Connect an a.f. output meter to the audio output terminals of the receiver.

(3) Set the TF 1066A modulation selector to C.W.; bring the CARRIER LEVEL meter pointer to the SET CARRIER mark, and adjust the ATTENUATOR to give an output which will not overload the receiver.

2.4.2. (continued)

(4) Tune the Signal Generator and the receiver to the test frequency; adjust the FINE TUNING control for maximum a.f. output; and, if necessary, readjust the SET CARRIER control.

(5) By means of the HUM ADJUST control, reduce the a.f. output from the receiver to a minimum.

When the above operations have been performed correctly, the f.m. on c.w. is less than 100 c/s deviation.

Microphony. Although every effort has been made to produce a design giving freedom from microphony, it has not been possible to eliminate this type of spurious modulation altogether. The operator is therefore advised to take normal precautions for preventing the excitation of modulation due to microphony.

For example, if the Signal Generator is to be used for signal-to-noise ratio or similar measurements where spurious modulation is particularly undesirable, it is an advantage to stand it on a sponge-rubber or felt mat. If the receiver delivers a high a.f. output, the loudspeaker should be directed away from the Signal Generator, or - better still - disconnected.

2.4.3. Frequency Modulation

The accuracy of the deviation indication and the waveform of the demodulated signal may tend to deteriorate slightly when carrier shift is applied by means of the INC FREQ controls. It is generally advisable, therefore, to keep the INC FREQ switch in its zero position when using frequency modulation.

(a) Internal F.M.

(1) Set the modulation-selector switch to INT F.M.

(2) Tune the Signal Generator, and adjust the ATTENUATOR and SET CARRIER controls to produce the required output in a manner similar to that described for c.w. operation.

(3) Set the monitor-selector switch to MOD 0-20 or MOD 0-100 depending on the deviation to be used.

2.4.3. (continued)

(4) Set the MOD FREQ toggle switch to 1 kc/s or 5 kc/s according to the modulation frequency required.

(5) Adjust the SET MOD control to bring the pointer of the MODULATION AND INCREMENTAL FREQUENCY meter to the required deviation indication.

Monitor Accuracy. At carrier frequencies below 110 Mc/s, the deviation indication is accurate to within 7% of full-scale deflection.

Between 110 Mc/s and 240 Mc/s, the indication is generally accurate to within 7% of f.s.d. but may fall outside this tolerance at certain frequencies in the band. A curve giving the correction for deviation against carrier frequency over the range 110 to 240 Mc/s is shown in red on the CORRECTION CHART FOR DEVIATION AND INCREMENTAL FREQUENCY MONITOR; this chart is in the form of a card and is normally stowed in the left-hand case-handle recess.

Above 240 Mc/s, the deviation accuracy falls to 20% of f.s.d. but an accuracy of 7% of f.s.d. can be obtained by applying the correction given by the black curve on the chart.

A.F. Synchronizing Signal. When the modulation selector is set to INT F.M., the internal modulating signal is available at the EXT MOD F.M. and earth terminals. It may be used as a convenient synchronizing signal when the Signal Generator is used in conjunction with a cathode-ray oscilloscope. At the maximum deviation of 100 kc/s, the level of this signal is of the order of 20 volts r.m.s. - see WARNING at the end of Sect. 2.3.3.

(b) External F.M.

(1) Set the modulation-selector switch to EXT F.M.

(2) Connect the external a.f. signal source to the EXT MOD F.M. and earth terminals - see WARNING at end of Sect. 2.3.3.

(3) Tune the Signal Generator and adjust the ATTENUATOR and SET CARRIER controls to produce the required output in a manner similar to that for c.w. operation.

(4) Set the monitor-selector switch to MOD 0-20 or MOD 0-100 depending on the deviation to be used.

2.4.3. (continued)

(5) Adjust the level of input from the external source to bring the pointer of the MODULATION AND INCREMENTAL FREQUENCY meter to the required deviation mark on the scale appropriate to the setting of the monitor-selector switch; apply the necessary correction to the meter reading for carrier frequencies above 110 Mc/s.

The impedance presented at the EXT F.M. and earth terminals to the external modulating source is nominally 5 kΩ. An input of the order of 20 volts is required to produce the maximum deviation of 100 kc/s. The deviation monitor is accurate to within ±5% of the accuracy at 1 kc/s over the range 30 c/s to 15 kc/s.

2.4.4. Amplitude Modulation

(a) Internal A.M.

(1) Set the modulation-selector switch to INT A.M. and turn the SET MOD control fully counter-clockwise.

(2) Tune the Signal Generator and adjust the ATTENUATOR and SET CARRIER controls to produce the required output level in a manner similar to that described for c.w. operation.

(3) Set the monitor-selector switch to MOD 0-20 or MOD 0-100 depending on the depth of modulation to be applied.

(4) Set the MOD FREQ toggle switch to 1 kc/s or 5 kc/s according to the modulation frequency required.

(5) Advance the SET MOD control until the pointer of the MODULATION AND INCREMENTAL FREQUENCY meter indicates the required modulation depth on the scale appropriate to the setting of the monitor-selector switch. The movement of the SET MOD control may cause a change in the deflection of the CARRIER LEVEL meter pointer; do not re-adjust the SET CARRIER control to bring the pointer back to the SET CARRIER mark.

2.4.4. (continued)

Monitor Accuracy. On the 0-20 range of the modulation monitor, the modulation-depth indication is accurate to within 2% modulation. On the 0-100 range, the indication is accurate to within 5% modulation up to 40%. Although the specified maximum modulation depth for the TF 1066A is 40%, modulation depths considerably greater than this can generally be obtained. Nevertheless, the specified maximum modulation depth should be borne in mind, and the modulation-depth indication should not be regarded as valid above 40%.

A.F. Synchronizing Signal. When the modulation-selector switch is in the INT A.M. position, the 1-kc/s or 5-kc/s input to the modulation amplifier is also applied to the EXT MOD A.M. and earth terminals. It may be used as a convenient synchronizing signal when the Signal Generator is used in conjunction with a cathode-ray oscilloscope. At 40% modulation depth, the level of this signal is of the order of 10 volts r.m.s.

(b) External A.M.

(1) Set the modulation-selector switch to EXT A.M.

(2) Tune the Signal Generator and adjust the ATTENUATOR and SET CARRIER controls to produce the required output in a manner similar to that described for c.w. operation.

(3) Set the monitor-selector switch to MOD 0-20 or MOD 0-100 depending on the modulation depth to be applied.

(4) Connect the external a.f. source to the EXT MOD A.M. and earth terminals; and adjust the input level until the pointer of the MODULATION AND INCREMENTAL FREQUENCY meter indicates the required modulation depth on the scale appropriate to the setting of the monitor-selector switch. If this action causes a change in the deflection of the CARRIER LEVEL meter, do not readjust the SET CARRIER control to bring the pointer of the meter back to the SET CARRIER mark.

The impedance presented at the EXT A.M. and earth terminals to the external modulating source is nominally 1 MΩ shunted by 20 pF. An input of the order of 10 volts is required to produce 40% modulation depth. Between 30 c/s and 15 kc/s the amplitude-frequency characteristic of the modulating circuit is flat to within 1 dB relative to the response at 1 kc/s.

2.5. R.F. OUTPUT ARRANGEMENTS

For consideration of its output circuit, the TF 1066A can be regarded as a zero-impedance voltage generator in series with a resistance of 50 ohms. This condition is shown diagrammatically in figure 1 of drawing No. TLC 28189, where E is the source e.m.f., R_O is the source impedance of the Signal Generator, Z_L is the load impedance, and V_L is the voltage actually developed across the load.

The Attenuator Dial. This dial has two scales: one is calibrated from -14 to +106 and denotes the output in decibels relative to 1 μV; the other is calibrated directly in units of voltage.

With the SET CARRIER control adjusted to bring the CARRIER LEVEL meter pointer to the SET CARRIER mark, the attenuator scales are direct reading, each in its particular units as described in the previous paragraph.

The Reversible Cursor. The transparent cursor fitted to the attenuator dial is reversible and is engraved with two hairlines, one vertical and one inclined at an angle corresponding to a 6-dB movement of the dial.

On one side of the cursor, the inclined hairline is marked E.M.F. FROM 50 OHM SOURCE and the vertical hairline is marked -6 dB. When the cursor is fitted with this side showing, the inclined hairline indicates the output level in terms of source e.m.f. (E in figure 1 of TLC 28189). The dial reading at the vertical hairline is the effective source e.m.f. when the 6-dB Attenuator Pad Type TM 4919/1 is in use. (See Section 2.5.1.).

On the other side of the cursor, the vertical hairline is marked VOLTS INTO 50 OHM LOAD and the inclined hairline is marked -6 dB. When the cursor is fitted with this side showing, the output level indicated by the vertical hairline is in terms of the potential (V_L in figure 1 of TLC 28189) developed across a 50-ohm load connected to the r.f. outlet of the Signal Generator. The dial indication at the inclined hairline is the voltage appearing across a 50-ohm load when the 6-dB Pad is in circuit.

To reverse the cursor:-

(1) Extract the centre screw securing the transparent plastic window of the attenuator dial.

(2) Remove the window and take off the spun-metal cover and spring at the centre of the dial.

2.5. (continued)

(3) Lift out the cursor, turn it over, and replace it.

(4) Replace the spring, the spun cover, and the transparent window; and secure them in position with the centre screw.

2.5.1. Output Accessories

Output CONNECTOR type TM 4824. This is a 50-ohm coaxial cable 30 inches long and fitted at either end with a standard type N free plug (Great Britain, Transradio Ltd. type GE.071: United States, Military No. UG-21B/U). These plugs mate with either standard type N free sockets (Great Britain, Transradio Ltd. type 6.043; United States, Military No. UG-23B/U) or panel mounting type N sockets (Great Britain, Transradio Ltd. type DE.071; United States, Military No. UG-22B/U).

20-dB Attenuator PAD type TM 4919. This is a conventional π-section attenuator pad with 20-dB insertion loss. The input resistance and output resistance are each 50 ohms. The applications of this pad are dealt with in Section 2.5.2, which follows. It is fitted with a type N socket at its input end and a type N plug at its output end.

6-dB Attenuator PAD type TM 4919/1. This pad has an insertion loss of 6 dB but is otherwise similar to the 20- dB PAD type TM 4919.

50-ohm to 75-ohm MATCHING UNIT type TM 4918. For details of the electrical action of this unit, refer to Section 2.5.2(c). When fitted it converts the effective source impedance of the Signal Generator from 50 ohms to 75 ohms. The MATCHING UNIT is fitted with a Type N socket at its input end a Belling Lee plug Type L734/P at its output end; this plug mates with a Belling Lee free socket Type L734/J or panel-mounting socket Type L604/S.

50-ohm to 300-ohm UNBALANCE TO BALANCE TRANSFORMER type TM 4916. The electrical action of this unit is described in Section 2.5.2(d), and it is used when the output of the Signal Generator is applied to a balanced-winding input circuit. The unit gives a line-to-line source impedance of 300 ohms. It contains resistive elements only and is not suitable for matching into balanced input circuits which are not in the form of windings. It is fitted with a Type N socket at its input end and solder spills at its output end.

2.5.1. (continued)

D.C. ISOLATING UNIT type TM 4917. This unit contains a 300-volt working 0.001-μF capacitor connected in series with the output line so that the Signal Generator may be connected to a point of high d.c. potential on the equipment under test. The ISOLATING UNIT is fitted with a Type N socket at its input end and two crocodile clips at its output end.

2.5.2. Coupling to the Equipment Under Test

The output impedance of the Signal Generator is nominally equal to the characteristic impedance of the CONNECTOR cable. This cable may therefore be regarded as correctly terminated at its input end; and serious errors in the apparent e.m.f. caused by standing waves on the cable can therefore generally be neglected even when the input impedance of the equipment under test is not equal to 50 ohms.

However, it is often important for other reasons that the source impedance is accurately matched to the load or that it has a particular known value not equal to 50 ohms. Under these circumstances, the source impedance at the output end of the system can be altered to the required value by the use of various matching networks. The paragraphs which follow give details of the various methods of coupling the Signal Generator via a selection of resistive impedance-correcting networks.

(a) Coupling from the 50-ohm Source

When the equipment under test has an input impedance other than 50 ohms and it is important that the signal is derived via a 50-ohm resistive source impedance, it is advisable, if the insertion loss can be tolerated, to couple the output CONNECTOR to the equipment via the 50-ohm 20-dB Attenuator PAD.

With the PAD in circuit, the possibility of error in apparent e.m.f. or effective output impedance due to standing waves is avoided because it is impossible to mis-match the cable seriously - variations in the load impedance from zero to infinity cause the effective line-terminating resistance to depart from its correct value by only 1 ohm approximately.

Figure 2 on Drawing No. TLC 28189 (following page 31) shows diagrammatically the effect of connecting the PAD into circuit. The final output conditions are equivalent to those of a zero-impedance generator producing an e.m.f. equal to E/10 in series with a resistance, R_{EO}, of

2.5.2. (continued)

50 ohms. The p.d. across the load can, of course, be calculated in the usual way and is equal to

$$\frac{E}{10} \times \frac{Z_L}{R_{EO} + Z_L}$$

where E is the e.m.f. indicated on the ATTENUATOR dial.

R_{EO} is the effective source resistance of the Signal Generator (50 ohms)

Z_L is the input impedance of the equipment under test.

If, however, the insertion loss of the 20-dB PAD cannot be tolerated, the 6-dB Attenuator PAD may be used instead. Although this PAD does not isolate the Signal Generator impedance from the load to the same degree as its 20-dB counterpart, it will usually be effective enough for all normal applications.

The final output conditions with the 6-dB PAD connected are equivalent to those of a zero-impedance generator producing an e.m.f. equal to E/2 in series with a resistance of 50 ohms. The p.d. across the load, is of course, equal to

$$\frac{E}{2} \times \frac{Z_L}{R_{EO} + Z_L}$$

(b) Source Resistance Less Than 50 ohms.

If the required source resistance is less than 50 ohms, the arrangement shown in figure 3 of TLC 28189 can be used. The resistance R_p is effectively in parallel with the source resistance of the Signal Generator so that the output resistance of the system, R_{EO}, is given by the standard expression for resistance in parallel; viz:

$$R_{EO} = \frac{R_p \times R_O}{R_p + R_O}$$

where R_O is the output resistance of the Signal Generator.

2.5.2. (continued)

Since the required output resistance is usually the known term, the above expression is more useful when rearranged as follows:-

$$R_p = \frac{R_O \times R_{EO}}{R_O - R_{EO}} \quad \ldots\ldots\ldots\

2.5.2. (continued)

(d) Using the Signal Generator with Balanced Loads.

With certain types of equipment, the input circuit is in the form of a balanced winding. Such equipment can be fed from the unbalanced output of the Signal Generator via two correcting resistors as shown in figure 5 of Diagram No. TLC 28189; this arrangement makes use of the auto-transformer effect of the centre-tapped winding to simulate the behaviour of a balanced source. One resistor, R_{s1}, is connected in series between the earthed screen of the output accessory in use and one side of the balanced winding, and a second resistor, R_{s2}, is connected in series with the 'live' output connection and the other side of the balanced winding.

The values of the two resistors, R_{s1}, and R_{s2}, can be calculated from the following expressions:

$$R_{s1} = \frac{R_{EO}}{2}$$

$$R_{s2} = \frac{R_{EO}}{2} - R_O \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

where R_{EO} is the required line-to-line output resistance of the Signal Generator

R_O is the source resistance of the Signal Generator (50 ohms).

The 50-ohm to 300-ohm UNBALANCED TO BALANCED TRANSFORMER type TM 4916 operates on the principle described above.

When feeding balanced loads by the method described above, it is advisable, if the insertion loss can be tolerated, also to include the 20-dB PAD or the 6-dB PAD. The effective source e.m.f. is, of course, then reduced by a factor of 20 dB or 6 dB.

E IS THE E.M.F. INDICATED ON THE ATTENUATOR DIAL

R_O IS THE OUTPUT RESISTANCE OF THE TF 801B—/1 = 50 OHMS

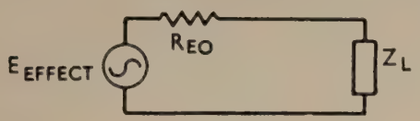
V_L IS THE P.D. ACROSS THE LOAD

Z_L IS THE LOAD IMPEDANCE

FIGURE 1 OUTPUT CONDITIONS FOR DIRECT COUPLING

OUTPUT CIRCUIT WITH 6-dB OR 20-dB PAD IN USE

THIS IS EQUIVALENT TO:—



WHERE $E_{EFFECT} = \frac{E}{2}$ FOR 6-dB PAD

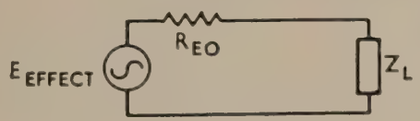
OR $\frac{E}{10}$ FOR 20-dB PAD

$R_{EO} = R_O$

FIGURE 2
OUTPUT CONDITIONS FOR COUPLING VIA AN ATTENUATOR PAD

OUTPUT CIRCUIT FOR SOURCE RESISTANCE < 50 OHMS

THIS IS EQUIVALENT TO:—



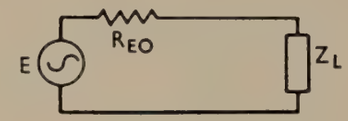
WHERE $E_{EFFECT} = E \frac{R_P}{R_P + R_O}$

$R_{EO} = \frac{R_P R_O}{R_P + R_O}$

FIGURE 3 OUTPUT CONDITIONS USING PARALLEL RESISTOR

OUTPUT CIRCUIT FOR SOURCE RESISTANCE > 50 OHMS

THIS IS EQUIVALENT TO:—

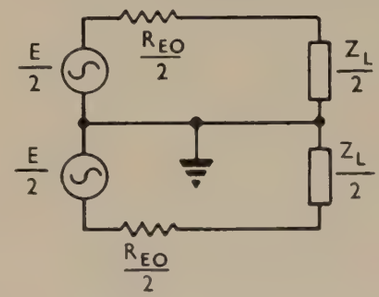


WHERE $R_{EO} = R_O + R$

FIGURE 4 OUTPUT CONDITIONS USING SERIES RESISTOR

OUTPUT CIRCUIT FOR BALANCED LINE-TO-LINE SOURCE RESISTANCE ≮ 100 OHMS

WHEN FEEDING INTO BALANCED WINDING THIS IS EQUIVALENT TO:—



WHERE R_{EO} = LINE-TO-LINE RESISTANCE

$R_O + R_{S2} = \frac{R_{EO}}{2}$

$R_{S1} = \frac{R_{EO}}{2}$

FIGURE 5
OUTPUT CONDITIONS FOR COUPLING TO BALANCED WINDING

OUTPUT ARRANGEMENT DIAGRAMS

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3. OPERATIONAL SUMMARY

When the user is familiar with the principles and techniques of operation detailed in Section 2, the following abridged instructions may be found a convenient guide for quick reference.

Frequency Range: 10 to 470 Mc/s

Source Impedance: 50 ohms

Open-Circuit Output Voltage: 0.2 μV to 200 mV

Modulation: F.M. up to 100 kc/s; can also be amplitude modulated

Frequency Shift: variable up to ±100 kc/s

Power Supply: 100 to 150 volts, 40 to 60 c/s;
180 to 250 volts, 40 to 60 c/s;
180 volts, 500 c/s.

Be sure that the power unit is correctly adjusted before switching the instrument on.

For further details, refer to Section 4.3.

TUNING

GENERAL: Set INC FREQ switch to its central-zero position,
Set RANGE switch to required band.
Use COARSE TUNING control to bring main tuning dial to required frequency.
Peak tuning to desired point on receiver response by means of FUNE TUNING control.

For further details, refer to Sect. 2.3.1.

3. (continued)

INCREMENTAL FREQUENCY ADJUSTMENTS

Variable Control: Set INC FREQ switch to VAR.
Set monitor selector to INC FREQ 20 kc/s or INC FREQ 100 kc/s.
Adjust incremental-frequency control to centralize pointer of MODULATION AND INCREMENTAL FREQUENCY meter. Tune to centre frequency of receiver by means of COARSE and FINE TUNING controls. Adjust incremental frequency control to produce required carrier shift as indicated by meter.

For further details refer to Section 2.3.2.

INC. FREQ. Switch: Set INC FREQ switch to its central zero position.
Tune to centre frequency of receiver under test by means of COARSE and FINE TUNING controls.
Use INC FREQ switch to produce required carrier shift.

For further details refer to Section 2.3.3.

Incremental Shift from External Source: Set INC FREQ switch to VAR.
Set monitor selector to INC FREQ 20 kc/s or INC FREQ 100 kc/s.
Connect external d.c. source to EXT MOD F.M. and earth terminals.
Adjust input level to produce required carrier shift as indicated on MODULATION AND INCREMENTAL FREQUENCY meter.

For details of external stepped control see Section 2.3.4.

3. (continued)

SETTING UP FOR C.W. OR MODULATED OUTPUT

C.W.: Set modulation selector to C.W.
Adjust SET CARRIER control to bring pointer of CARRIER LEVEL meter to its SET CARRIER mark.

For further details see Section 2.4.1.

FREQUENCY MODULATION

Internal: Set modulation selector to INT F.M.
Set monitor selector to MOD 0-100 or MOD 0-20.
Adjust SET MOD control to bring pointer of MODULATION AND INCREMENTAL FREQUENCY meter to required reading.

For further details see Section 2.4.3.

External: Set modulation selector to EXT F.M.
Connect modulating source to EXT MOD F.M. and earth terminals.
Set monitor selector to MOD 0-100 or MOD 0-20.
Adjust level of external source to bring pointer of the MODULATION AND INCREMENTAL FREQUENCY meter to required reading.

For further details see Section 2.4.3.

AMPLITUDE MODULATION

Internal: Set modulation selector to INT A.M.
Set monitor selector to MOD 0-100 or MOD 0-20.
Adjust SET MOD control to bring pointer of MODULATION AND INCREMENTAL FREQUENCY meter to required reading.

For further details see Section 2.4.4.

3. (continued)

External: Set modulation selector to EXT A.M.
Connect external modulating source to EXT MOD A.M. and earth terminals.
Set monitor selector to MOD 0-100 or MOD 0-20.
Adjust level of external source to bring pointer of MODULATION AND INCREMENTAL FREQUENCY meter to required reading.

For further details see Section 2.4.4.

SETTING R.F. OUTPUT LEVEL

ATTENUATOR DIAL:

Adjust ATTENUATOR control to produce (i) a dial indication of required output e.m.f. or (ii) an indication of required p.d. across a 50-ohm load connected to R.F. OUTPUT socket. Type of indication depends upon position of cursor.

For details see Section 2.5.

4. MAINTENANCE

4.1. GENERAL

The following items (for details see APPENDICES, Page 72) are included in this handbook to assist in the maintenance of the FM Signal Generator Type TF 1066A:-

Functional Diagram
Complete Circuit Diagrams
Component Layout Illustrations
Spares Ordering Schedule with Circuit References
Valve Replacement Data Sheets

Section 1, DESCRIPTION, of this handbook deals with the internal circuits of the Signal Generator and is intended to be read in conjunction with the Circuit and Functional Diagrams included at the end of this manual. It is strongly recommended that, before commencing the adjustment or replacement of component parts of the instrument, the user should familiarize himself with the principles described in Section 1 and illustrated in the diagrams.

The Circuit Diagram shows all the electric components contained in the instrument. The descriptions of these components - their types, values, ratings, etc. - are given in the Spares Ordering Schedule; the Schedule also lists certain mechanical components.

The physical location of electrical components is shown in the Component Layout Illustrations.

4.2. REPLACEMENT OF FUSES

The mains-input and h.t. circuits of the TF 1066A are protected by three cartridge fuses; two 2-amp in the supply lines and a 250-mA in the mains transformer h.t. centre tap line. These fuses are located in the right-hand case-handle recess and can be replaced without removing the instrument from its case.

4.3. MAINS INPUT ARRANGEMENTS

4.3.1. General

The instrument can be adjusted to operate from any supply within the ranges 100 to 150 volts and 180 to 250 volts, 40 to 60 c/s, and also 180 volts, 500 c/s.

The mains transformer has a double-wound primary, and its two tapped sections are connected in series for 180- to 250-volt operation or in series-parallel for 100- to 150-volt operation.

The mains input to the transformer is carried on two fly-leads which are connected by screws to the mains tapping panel. Attached to the tapping panel is a pierced reference plate which is reversible and marked with a selection of voltages. On one side of the plate, the voltages are applicable to the 100- to 150-volt range; on the other side, to the 180- to 250-volt range.

The two main sections of the double-wound primary are connected together by a link or links; these links are used to join the appropriate solder-tag terminals which are mounted directly on the transformer coil. To change from one major voltage range to the other, the linking between the transformer tags is altered; to change by a small, say 10-volt, increment within one of the major voltage ranges, the position of the screw-secured fly-leads on the tapping panel is altered. Diagram TLC 27612, included after Page 38, shows, in schematic form, the method of adjusting the mains transformer.

In order to examine the transformer connections fully, the instrument must be removed from its case as described in Section 4.5.1.

If it is required to view, or alter, the position of the fly-leads on the tapping panel, the instrument case need not be removed; the tapping panel is located in the right-hand case-handle recess.

4.3.2. Operation From 180- to 250-volt, 40- to 60-c/s Supplies

To adjust the instrument to operate from 180- to 250-volt supplies, connect the link on the transformer coil and the lead from the mains tapping panel as shown in figure 1 of TLC 27612. Also, make sure that pins 5 and 6 of V1 are linked (see MP 1066A-5). Finally, adjust the position of the fly-leads to the mains tapping panel as necessary.

4.3.3. Operation From 100- to 150-volt, 40- to 60-c/s Supplies

To adjust the instrument to operate from 100- to 150-volt supplies, connect the links on the transformer coil and the lead from the mains tapping panel as shown in figure 2 of TLC 27612. Also, make sure that pins 5 and 6 of V1 are linked (see MP 1066A-5). Finally, adjust the position of the fly-leads to the mains tapping panel as necessary.

4.3.4. Operation From 180-volt, 500 c/s Supplies

To adjust the instrument to operate from 180-volt, 500-c/s supplies, connect the link on the transformer coil and the lead from the mains tapping panel as shown in figure 1 of TLC 27612. Disconnect the link between pins 5 and 6 of V1* (see MP 1066A-5). Finally, connect the fly-leads to the '0V' and '180V' taps on the mains tapping panel.

*When operating from 40- to 60-c/s supplies, the a.c. voltage feeding the negative line voltage doubler circuit is applied via a 0.55 μF composite capacitor comprising C24 and C47. To operate from 500-c/s supplies, this value of capacitance must be reduced. The circuit wiring is so arranged that the reduction is effected by simply breaking the link between pins 5 and 6 of V1.

4.4. REPLACEMENT OF VALVES AND CRYSTALS

All l.f. and power unit valves are immediately accessible on removing the instrument case as described in Section 4.5.1. The two remaining valves, V2 and V6, are enclosed within the r.f. unit; to remove the r.f. unit cover, refer to Section 4.5.3. The method of removing V6 (a disk-seal triode) is given in Section 4.5.4.

For details of suitable replacement valves, refer to the Valve Replacement Data Sheets, VRD 1066A, supplied with this handbook.

When replacing V2, check the deviation calibration accuracy as detailed in Section 4.9.7. When replacing V9, check the modulation monitor accuracy as detailed in Section 4.9.11.

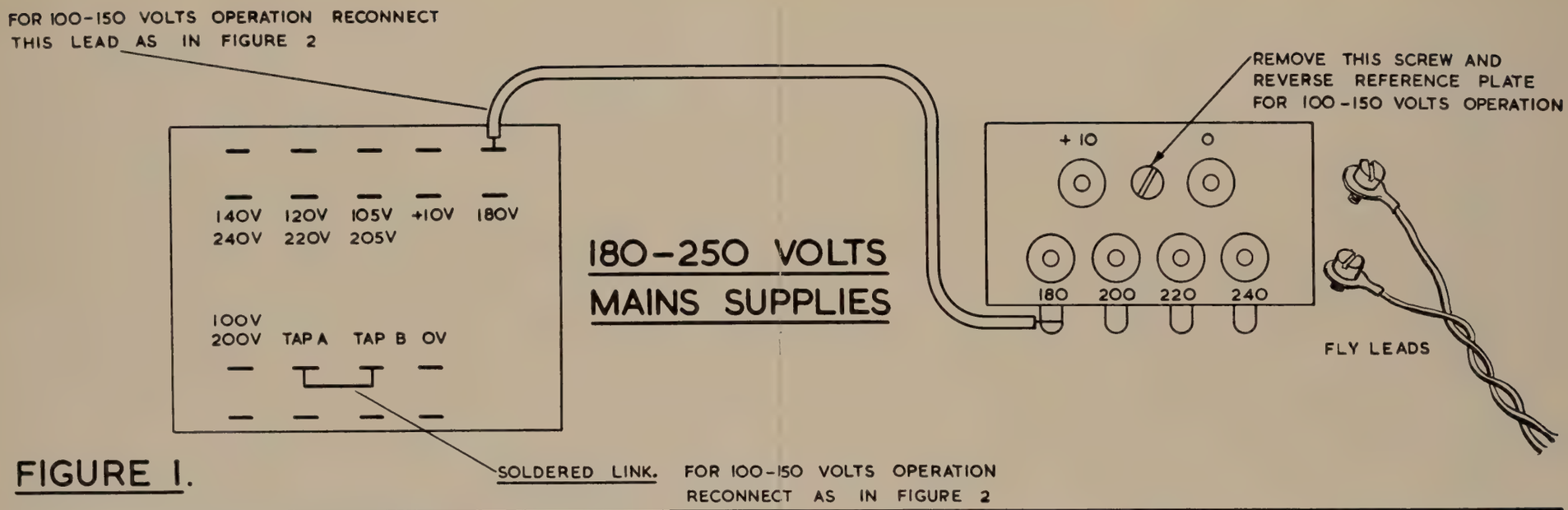
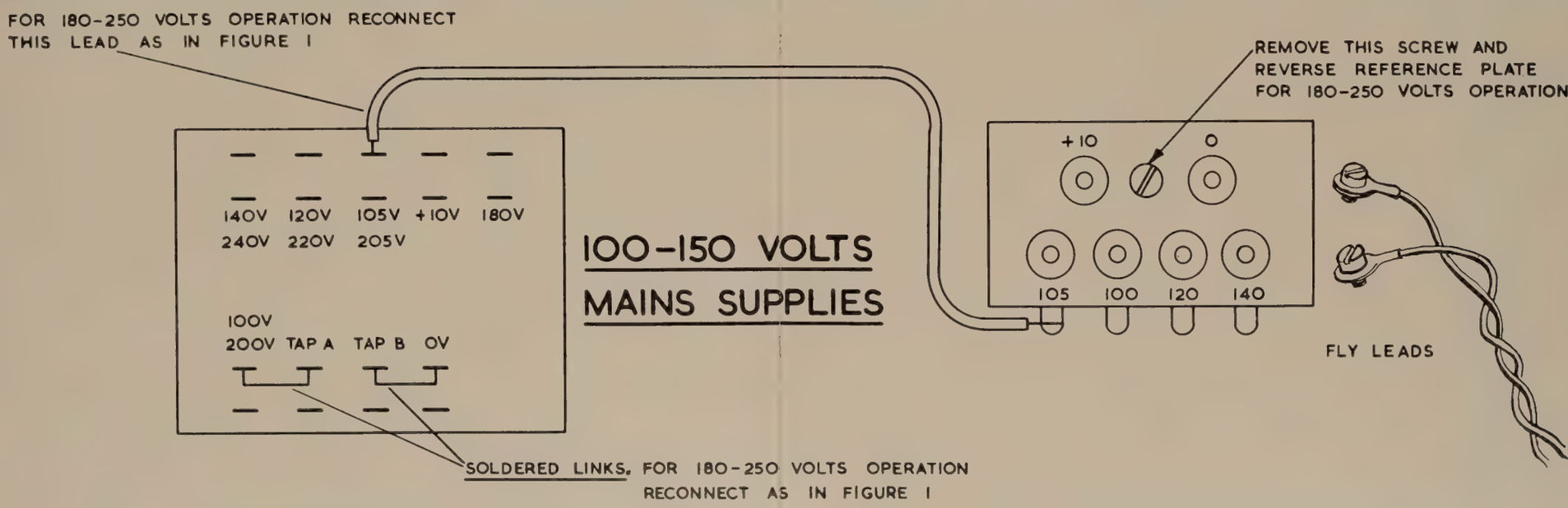


FIGURE 1.



A ARRANGEMENT OF PRIMARY SOLDER TAG CONNECTIONS ON MAINS TRANSFORMER

B MAINS TAPPING PANEL
CONNECT THE FLY-LEADS TO GIVE A COMBINATION TO SUIT MAINS VOLTAGE.
ONE FLY-LEAD MUST GO TO EITHER '+10' OR '0' TAP

FIGURE 2.

M.I. LTD. 1—1/58

C.P. 4c. 4/60

4.4. (continued)

The r.f. level detector diode (silicon-crystal), MR2, is mounted adjacent to the mouth of the piston attenuator tube; to remove this diode, refer to Section 4.5.5. The modulation monitor diodes, MR3 and MR4, are mounted on the l.f. chassis adjacent to the modulation transformer, T2.

If MR2, MR3 and/or MR4 are replaced, check the carrier-level and modulation monitor accuracies as detailed in Section 4.9.5. and 4.9.11.

4.5. DISMANTLING THE INSTRUMENT

4.5.1. To Remove the Case

(1) Lay the instrument on its face.

(2) Take out the four countersunk screws holding the case feet to the instrument.

(3) Take out the four similar screws from the rear of the case.

(4) Lift the case upwards and, at the same time, feed the mains lead through the aperture in the left-hand case-handle recess.

4.5.2. To Remove the Front Panel Surround

(1) Remove the instrument case as described in Section 4.5.1.

(2) Take out the fourteen cheese-headed screws around the rear edge of the front panel.

4.5.3. To Remove the R.F. Unit Cover

(1) Remove the instrument case as described in Section 4.5.1.

(2) Take out the thirty screws around the edge of the r.f. unit cover.

4.5.4. To Remove the Oscillator Valve, V6

(1) Remove the r.f. unit cover as described in Section 4.5.3.

(2) Slacken the screws holding the corrugated bands round the anode and grid rings of the valve.

(3) Pull the valve out through the bottom of the instrument at the same time releasing the cathode/heater socket which is a push fit.

4.5.5. To Remove the R.F. Level Monitor Diode, MR2

(1) Remove the r.f. unit cover as described in Section 4.5.3.

(2) Pull the diode clear of its retaining spring with the aid of a pair of small forceps. The diode can then be removed completely from the attenuator assembly.

4.5.6. To Remove the Frequency Dial and Dial Housing

(1) Detach the perspex dial cover, its centre mask, and the spring beneath the mask, by releasing the captive screw at the centre of the dial. Lift out the cursor.

(2) Remove the dial after taking out the three countersunk screws from around the centre of the dial.

(3) Remove the dial housing by undoing four nuts exposed by the removal of the dial.

4.5.7. To Remove the F.M. Deviation Tracking Potentiometer, RV2

(1) Remove the instrument case as described in Section 4.5.1.

(2) Remove the frequency dial and dial housing as described in Section 4.5.6.

(3) Slacken the two grub-screws securing the potentiometer spindle to its associated gearwheel.

4.5.7. (continued)

(4) Undo the nut which holds the potentiometer to its spring-tensioned support bar.

(5) Withdraw the potentiometer. The gearwheel can now also be removed.

It is important that the angular position of RV2 is correctly set relative to the rotor of the tuning capacitor. The setting must be such that the rotation of the frequency control is limited by the stop mechanism in the 55:1 reduction unit and not by the end stops of the potentiometer.

Therefore, when reassembling the gear drive assembly, make sure that the gears are meshed in their correct relative positions and check the f.m. deviation accuracy as described in the appropriate sub-section of Section 4.9., SCHEDULE OF TESTS. Also check the accuracy of frequency calibration; the position of the frequency dial gear will most probably have been altered.

The method of adjusting the positions of the gears is detailed in Section 4.5.10.

4.5.8. To Remove the R.F. Unit

It is strongly recommended that the component parts of the r.f. unit should not be dismantled or their positions altered unless it is absolutely necessary and unless the user has the necessary test equipment at his disposal for recalibration. Where practicable, the signal generator should be returned to Marconi Instruments, Service Department for repair and recalibration.

If the drive gears are unmeshed for any reason, refer to the final paragraphs of Section 4.5.10.

(1) Remove the instrument case as described in Section 4.5.1.

(2) Remove the frequency dial and the dial housing as described in Section 4.5.6.

(3) Remove the r.f. unit cover as described in Section 4.5.3.

(4) Detach the COARSE FREQUENCY and RANGE Mc/s control knobs by removing the screw from the centre of each.

4. 5. 8. (continued)

(5) Unsolder the eight leads which connect the r. f. unit with the main body of the instrument. These leads are designated "A" to "H" on MP 1066A-6. Also detach the "earthy" end of R47, in series with the HUM ADJUST control, from the r. f. unit casting.

(6) Slacken the two grub-screws which secure the bellows coupling to the piston attenuator pinion spindle.

(7) Remove the R. F. OUTPUT socket from the front panel.

(8) Take out eight screws from the front panel and remove the r. f. unit and attenuator assembly complete from the instrument. The eight screws are designated "J" on MP 1066A-1.

4. 5. 9. To Remove the Filter Unit Assemblies

(1) Remove the instrument case as described in Section 4. 5. 1.

(2) Remove the r. f. unit cover as described in Section 4. 5. 3.

(3) Unsolder the leads from the terminals of the appropriate filter or filters.

(4) Extract the four screws holding the appropriate filter unit to the side of the r. f. box.

(5) Withdraw the filter unit from the r. f. unit assembly. The four filters mounted along the rear edge of the r. f. box are withdrawn from the inside whereas the two units nearest the front panel are withdrawn outwards.

It is not advisable to separate the inner and outer sections of the filter units unless the user has suitable equipment available. This is because the two sections are a tight fit and soldered to ensure good screening. If a hand press is available, the inner section can be pushed out by the application of a suitably shaped drift after the solder has been removed.

4. 5. 10. To Remove the Frequency Drive Gears

(a) Remove the instrument case as described in Section 4. 5. 1.

(1) Frequency Dial Gear

(b) Slacken the two grub-screws which hold the gearwheel to the frequency dial spindle and remove the gear.

(2) Potentiometer Gear

(c) Remove the frequency dial as described in (1) and (2) of Section 4. 5. 6.

(d) Slacken the two grub-screws which hold the gear to the potentiometer spindle.

(e) Unscrew the nut which secures the potentiometer to its support arm and pull the potentiometer through the cut-out in the dial housing until the spindle is clear of the gear.

(3) 55:1 Reduction Unit

(f) Remove the frequency dial housing as described in (3) of Section 4. 5. 6.

(g) Remove the r. f. unit as described in Section 4. 5. 8.

(h) Slacken the two grub-screws which hold the bellows coupling to the reduction unit "output" spindle.

(i) Detach the four screws from the resistance panel incorporating R70 etc., and move the panel to one side.

(j) Remove the two cheese-headed screws thus exposed and pull the reduction unit clear of the main assembly.

(4) Bottom Gear

(k) Slacken the two grub-screws which hold the bellows coupling to the tuning capacitor rotor spindle and pull the bottom gear clear of the main assembly.

4. 5. 10. (continued)

It is important that the angular positions of the frequency dial and of the f. m. -deviation-potentiometer gears are correctly set relative to the rotor of the tuning capacitor. This is necessary so that the frequency calibration remains correct and so that the limit of rotation is controlled by the stop mechanism in the 55:1 reduction unit and not by the end stops of the potentiometer.

Therefore, when reassembling the gear drive assembly, make sure that the gears are meshed in their correct relative positions and check the frequency calibration and f. m. deviation accuracy as described in the appropriate sub-section of Section 4. 9, SCHEDULE OF TESTS.

To alter the position of either or both of the upper gears, it is first necessary to bring the stop bar away from the potentiometer support arm; this stop is held in position by two nuts, one on either side of the r. f. unit support casting. The gears can then be unmeshed and their positions adjusted as necessary.

When the gears are correctly meshed, the stop bar must be adjusted so that the potentiometer gear cannot come out of mesh.

4. 5. 11. To Remove the R. F. Turret

It is strongly recommended that the component parts of the r. f. unit should not be dismantled or their positions altered unless it is absolutely necessary and unless the user has the necessary test equipment at his disposal to recalibrate the signal generator. Where practicable, the signal generator should be returned to Marconi Instruments, Service Department for repair and recalibration.

(1) Remove the instrument case as described in Section 4. 5. 1.

(2) Remove the r. f. unit as described in Section 4. 5. 8.

(3) Remove the 55:1 reduction unit and the bottom gear as described in (3) and (4) of Section 4. 5. 10.

(4) Detach the two screws which hold the valve mounting assembly and coupling capacitor to the side of the r. f. box. It is sufficient to leave this sub-assembly floating.

4.5.11. (continued)

(5) Remove the two screws which secure the r.f. chassis to the two hexagonal pillars.

(6) Slacken the four cheese-headed screws which hold the end of the r.f. chassis to the side of the r.f. box. Note the number of shims fitted between the r.f. box and the chassis and make sure that they are refitted in the same sequence. When slackening these screws, take care that the ball in the turret thrust bearing does not fall out and become lost.

IMPORTANT: When replacing this chassis, make sure that the screws which hold the end of the r.f. chassis to the side of the r.f. box are at the front edge of the slots in the chassis before the screws are finally tightened. The end-thrust bearing should then be adjusted for minimum rotor end float consistent with freedom of movement.

(7) Remove the lower of the two hexagonal bars.

(8) Pull the r.f. turret towards the rear of the r.f. unit and tilt it sideways so that it can be drawn clear of the r.f. unit.

4.5.12. To Remove the Valve Coupling Capacitor Assembly.

It is strongly recommended that the component parts of the r.f. unit should not be dismantled or their positions altered unless it is absolutely necessary and unless the user has the necessary test equipment at his disposal to recalibrate the Signal Generator. Where practicable, the Signal Generator should be returned to Marconi Instruments, Service Department for repair and recalibration.

(1) Remove the instrument from its case as described in Section 4.5.1.

(2) Remove the r.f. unit cover as described in Section 4.5.3.

(3) Unsolder the leads connecting the bifilar choke, L2, to the two l.t. filter assemblies, TM 4883E, and detach the screw holding L2 to the r.f. chassis.

4.5.12. (continued)

(4) Unsolder the lead connecting the V6 anode choke, L1, to the "Monitor" filter unit.

(5) Unscrew the two nuts which hold the sub-assembly insulating plate to the pillars.

(6) Take out the two screws which hold the valve coupling capacitor plates to the side of the r.f. box.

(7) Insert a 4-BA hexagonal key through the centre of the support pillars and unscrew the threaded portions of the pillars until the pillars can be removed from the r.f. unit.

(8) Draw the sub-assembly and the oscillator valve clear of the r.f. unit.

4.5.13. To Remove the Attenuator

(1) Remove the instrument case as described in Section 4.5.1.

(2) Remove the r.f. unit cover as described in Section 4.5.3.

(3) Detach the R.F. OUTPUT socket from the front panel.

(4) Slacken the three screws which clamp the two bands around the mouth of the attenuator tube.

(5) Slacken the two grub-screws which hold the bellows coupling to the attenuator drive pinion spindle; remove the bolt which holds the attenuator-tube support plate to the hexagonal bar attached to the dial-housing frame.

(6) Detach the two screws which hold the valve-mounting sub-assembly to the side of the r.f. box. Leave this sub-assembly floating.

(7) Remove the nine screws and nuts which hold the stiffening plate to the side of the r.f. box.

NOTE: The four screws disposed around the periphery of the attenuator tube secure the tube, as well as the stiffening plate, to the r.f. box; therefore, it is advisable to detach these screws last of all.

4.5.13. (continued)

(8) Draw the attenuator assembly free from (a) the bellows coupling, (b) the two bands, and (c) the r.f. unit.

(9) Detach the pressure plate which limits the movement of the rack drive.

(10) Push the attenuator head and rack assembly out through the "r.f." end of the attenuator tube.

There are three points that should be particularly noted when re-assembling the attenuator, they are: (i) the position of the r.f. level monitor pick-up loop, (ii) the mechanical construction of the r.f. by-pass capacitor, C14, and (iii) the insertion of the earthing tongues around the pick-up head into the attenuator tube.

(i) Make sure that the "high" end of the r.f. level monitor loop is situated squarely in the slot cut in the attenuator tube and does not short to chassis.

(ii) The r.f. by-pass capacitor, C14, is formed by the attenuator tube, the wider of the two bands encircling the tube, and a strip of insulating material inserted between the two. When removing or replacing the band, take care that the insulator does not get damaged. The value of this capacitance is nominally 200 μμF.

(iii) When replacing the attenuator pick-up head in the attenuator tube, pay particular attention to the beryllium-copper earthing tongues and make sure they do not get damaged.

After the reassembly is complete, the r.f. level and amplitude modulation accuracy must be checked as described in the appropriate sub-section of Section 4.9., SCHEDULE OF TESTS.

4.6. WORKING VOLTAGES

The following power supply and valve electrode voltages were obtained from a representative TF 1066A; the voltmeter employed had a resistance of 20 kΩ/volt.

4.6.1. Power Supply Voltages

HT a.c.	(pins 4 and 6 of V1 and chassis)	350-0-350 V a.c.
HT rect.	(top cap of V3 and chassis)	410 V d.c.
HT ref.	(pin 2 of V4 and chassis)	83 V d.c.
HT stab.	(pin 3 of V3 and chassis) *	280 V d.c.
-ve line	(chassis and pin 2 of V10)	108 V d.c.

* adjusted by means of RV4

LT1	(across transformer tags on T1)	6.3 V a.c.
LT2	(" " ")	6.3 V a.c.
LT3	(" " ")	5.0 V a.c.
LT4	(across tags 'S' and 'F' on T1)	24 V.a.c.
V6 fil.	(across cathode/heater socket of V6) **	6.5 V a.c.

** adjusted by means of R87 and R89

4.6.2. Electrode Voltages

The controls to be set as follows:

Carrier Frequency:-	20 Mc/s
Modulation Switch:-	INT. F.M.
MOD. FREQ. Switch:-	1 kc/s
CARRIER LEVEL Meter:-	SET CARRIER Mark
Deviation:-	100 kc/s

Valve	V_a	V_{sc}	V_k
V2	220	220	17
V6	150	-	-
V7	260	-	9
V8	250	250	23
V9a	92	-	5.5
V9b	280	-	75

4.7. D.C. RESISTANCE OF INDUCTORS

The following approximate d.c. resistance of inductors and transformers are included to assist the user in the routine maintenance of the Signal Generator. No values are quoted where the resistance is too low to give a readable indication on a multi-range testmeter.

Component	Approximate D.C. Resistance
L1	190 Ω
L6	1000 Ω
L11 + L12	11 Ω
L20 + L21	11 Ω
L22 + L23	11 Ω
T1 (Pri. 'TAP B' to '140/240V')	15 Ω
T1 (Pri. 'TAP B' to '120/220V')	13 Ω
T1 (Pri. 'TAP B' to '105V')	11.5 Ω
T1 (Pri. 'TAP B' to '100/200V')	11 Ω
T1 (Pri. 'TAP B' to '180V')	8.5 Ω
T1 (Pri. 'TAP A' to '0V')	10 Ω
T1 (Pri. 'TAP A' to '+10V')	11 Ω
T1 (Sec. 'HT - CT - HT')	200-0-200 Ω
T2 ('1' to '2')	180 Ω
T2 ('1' to '4')	220 Ω
T2 ('5' to '7')	55 Ω
TR1 ('Red' to 'Black')	220 Ω

4.8. PRESET OR SPECIALLY SELECTED COMPONENTS

In the manufacturing data for the TF 1066A, certain of the components are either specified as being of the preset type or designated for individual selection, the setting or selection of the components being carried out during the factory calibration of the instrument; this is necessary since the operating characteristics of the instrument have to conform to a quantative specification including maximum and minimum limits of permissible error.

The Description column of the Spares Ordering Schedule shows which of the components are of the preset type; components which are

4. 8. (continued)

individually selected are distinguished in that column by a single asterisk mark.

If, in servicing a TF 1066A, it is necessary to replace any of these components, it is also necessary, if the performance or accuracy of the instrument is not to be impaired, to repeat the factory calibration procedure by which the components were originally selected.

Section 4. 9. gives a range of tests by which the main points of performance of the instrument can be checked; this section also deals with the adjustment of preset components and with the choice of value for individually selected components.

It will be appreciated that it may sometimes be necessary to reselect a selected component, or readjust a preset component, even though that component itself has not been found faulty and replaced in initial servicing operations. For example, the resistors forming the correcting network preceding the reactor driver valve, V2, must be specially selected to suit the characteristics of the ferrite modulator, TR1. If TR1 were replaced, then it would be quite likely that with the original resistors the f. m. deviation would be outside the specified limits of accuracy and that preset resistors RV10 and RV11 would have to be readjusted.

It therefore follows that, in all servicing operations involving replacement of components, the user should consider carefully the possible effects on the performance of the stage or stages involved.

The table which follows lists all the preset and specially selected components contained in the instrument and indicates the section in which adjustment or selection of each component is described.

4.8. (continued)

Component	Section Describing Adjustment or Selection	Component	Section Describing Adjustment or Selection
RV4	4.9.6.	R76	4.9.6.
RV7	4.9.11.	R77	4.9.6.
RV8	4.9.5.	R78	4.9.6.
RV10	4.9.7.	R79	4.9.6.
RV11	4.9.7. and 4.9.8.	R80	4.9.6.
R6	4.9.8.(E)		
R7	4.9.8.(D)	R81	4.9.5.
R8	4.9.8.(C)	R82	4.9.5.
R9	4.9.8.(B)	R83	4.9.5.
R10	4.9.8.(A)	R84	4.9.5.
R11	4.9.8.(A)	R85	4.9.5.
R26	4.9.10.		
R39	4.9.11.		
R44	4.9.8.(A)	C9	4.9.4.
R48	4.9.8.(C)	C46	4.9.12.
R50	4.9.8.(E)	C48	4.9.4.
R51	4.9.8.(D)	C50	4.9.12.
R59	4.9.8.(B)	C54	4.9.5.
R60	4.9.9.		
R69	4.9.9.	L7	4.9.3.
R70	4.9.9.	L8	4.9.3.
R71	4.9.9.	L9	4.9.3.
R72	4.9.9.	L10	4.9.3.
R73	4.9.9.	L11	4.9.3.
R74	4.9.9.		

4.9. SCHEDULE OF TESTS

The following information, based on abstracts from the internal Factory Test Schedule, is included to enable the user to carry out a series of tests by which the main points of performance of the instrument can be checked; it also gives details concerning the adjustment to preset components and the choice of value for individually selected components.

4.9.1. Apparatus Required

(a) Insulation Tester, 750-volt.

(b) Crystal Calibrator with 5- and 1-Mc/s crystal oscillators and 'difference frequency' output facilities; Marconi Type TF 723 (Series). If available, use a calibrator with a 100-kc/s oscillator in addition to the 5- and 1-Mc/s oscillators referred to above. If a 100-kc/s oscillator is not available, refer to the note at the end of Section 4.9.3.

(c) Cathode-Ray Oscilloscope.

(d) A.F. Oscillator, 30 c/s to 100 kc/s, 25 volts output; Marconi Type TF 885 (Series).
NB. Marconi Types TF 195 (Series) and TF 894 (Series) can be used for all checks in which this item is required except the test concerning the variable INC. FREQ. control (Sections 4.9.7. and 4.9.8.). Marconi Type TF 1101 is suitable for all checks except that the maximum output is 20 volts.

(e) A.C. Voltmeter, 0 to 50 volts; Marconi Types TF 428 (Series), TF 958, TF 1041 (Series), TF 1100, or TF 1300.

(f) Wave Analyser; Marconi Type TF 455E.

(g) Diode Voltmeter, 0 to 100 mV, 50-ohm impedance; for details refer to figure 1 of Drg. No. TLB 28315 included at the end of this manual.

(h) Receiver, 10 to 470 Mc/s, 1 μV sensitivity.

(i) Standardized Signal Generator, 50 ohms source impedance, 100 mV output, 10 to 470 Mc/s frequency range; Marconi Types TF 801B (series) or TF 1066 (Series).

4.9.1. (continued)

(j) Two Variable Resistors, 20 kΩ.

(k) Carrier Deviation Meter, covering the carrier frequency range 10 to 470 Mc/s, deviation range 0 to 100 kc/s; Marconi Types TF 791C, TF 928 (20 Mc/s min. carrier frequency), or TF 934 (75 kc/s max. deviation).
NB. For the F.M. on C.W. check (Section 4.9.14), where deviations of less than 100 c/s have to be measured, it is essential that the deviation meter should either be modified to operate from battery supplies, or, incorporate facilities allowing its local oscillator to be brought under crystal control.

(l) Diode Mixer.
(m) High-Resistance Headphones.
) Use in conjunction with a.f. oscillator (item d); for details see figure 2 of Drg. No. TLB 28315 included at the end of this manual.

4.9.2. Insulation (Apparatus Reqd: Item a)

This test can be done with the instrument in or out of its case.

Measure the insulation resistance between chassis and each live pin of the mains supply plug in both positions of the SUPPLY ON/OFF switch.

The insulation resistance should be not less than 40 MΩ.

4.9.3. Frequency Calibration (Apparatus Reqd: Item b)

The frequency calibration should be checked with the instrument in its case.

Before any other adjustments are made to the r.f. unit of the Signal Generator, it is important that the tuning coils are so adjusted that the full frequency cover on each band is obtainable. For this reason, the instructions for checking the frequency calibration are given before those for the remaining tests and adjustments. However, if it is found necessary to make any major adjustment in the r.f. unit, the frequency calibration should always be rechecked.

4. 9. 3. (continued)

Furthermore, if it is found necessary to recalibrate the frequency dial, this should always be done finally after the other tests and adjustments detailed in this schedule have been completed. A rough calibration may be marked on the dial initially as a guide for use when making adjustments to the instruments.

The procedure for checking the calibration is as follows:-

(1) Switch ON the mains supply and set the modulation selector to C. W.

(2) Adjust the FINE TUNING control to mid-travel, and set the INC FREQ switch to its central zero position.

(3) Connect the output of the Signal Generator to the crystal calibrator.

(4) Check the frequency calibration accuracy against the harmonics of the 5-Mc/s and 1-Mc/s oscillator of the crystal calibrator.

The frequency calibration should be accurate to within 1% of the indicated frequency.

If the frequency calibration is inaccurate by a linearly equivalent amount on all frequency bands and over the whole of each band, the tuning dial may have moved relative to the tuning capacitor spindle.

If there is an error on one band only or irregularly distributed errors, it may be possible to correct the calibration by adjustment of the cores of the tuning inductors on Bands A to C or by adjustment of the length of the inductor strip on Bands D and E.

If it is not possible to correct the existing dial calibration, fit a new blank tuning dial and recalibrate. In order to eliminate any possibility of the calibration being rendered inaccurate by subsequent adjustment to the instrument, it is advisable to make all the remaining tests and adjustments described in this schedule before proceeding to recalibrate the tuning dial.

When recalibrating the dial, it may be necessary to make an approximate calibration using a receiver (Item h of Apparatus Required) before marking the accurate calibration on the dial using the crystal calibrator. This prevents the possibility of selecting the wrong harmonic of the calibrator's crystal oscillator for any given dial marking.

4.9.3. (continued)

Calibrate the dial at:

every 100 kc/s* on Band A (10-22 Mc/s)
" 200 kc/s* " " B (22-48 Mc/s)
" 1 Mc/s " " C (48-110 Mc/s)
" 2 Mc/s " " D (110-240 Mc/s)
" 5 Mc/s " " E (240-470 Mc/s)

* If the crystal calibrator in use does not incorporate a 100-kc/s oscillator, it is permissible, though not recommended, to calibrate every 1-Mc/s point and to interpolate the intermediate frequencies.

4.9.4. Internal Modulation Oscillator (Apparatus Reqd: Items c, d, e and f)

This test should be made with the instrument out of its case.

(1) Connect the Y input terminals of the oscilloscope to the EXT MOD F.M. and earth terminals of the Signal Generator.

(2) Connect the audio-frequency oscillator to the X input of the oscilloscope.

(3) Set the modulation selector of the Signal Generator to INT F.M.

(4) Use the lissajous figure method of checking the frequency of the modulating oscillator in both the 1-kc/s and 5-kc/s positions of the MOD. FREQ. switch.

The frequency should be within 5% of that indicated by the setting of the switch. If necessary adjust the frequency by selecting new values for capacitors C9 and C48.

(5) Measure the output voltage of the modulating oscillator between tags 5 and 7 of transformer T2 by means of multi-range test meter.

The output should not be less than 25 volts.

(6) Connect the wave analyser between the EXT MOD F.M. and earth terminals of the Signal Generator and measure the levels of the 2nd- and 3rd-harmonics in the modulation signal. In general they can be expected to be not greater than 2.5% and 2% of the fundamental level respectively.

4.9.5. Carrier Level Monitor (Apparatus reqd: Items g, h, and i)

This test should be carried out with the instrument out of its case.

The CARRIER LEVEL meter accuracy can be adjusted by means of potentiometer RV8 and resistors R81 to R85. RV8 controls the overall accuracy whereas R81 to R85 are adjusted individually for each range.

Therefore, if a constant error, common to all bands, exists, correction can be effected by adjustment of RV8. If, however, the error affects only some of the bands, the appropriate resistors, R81 to R85, should be reselected.

The complete procedure for setting up the CARRIER LEVEL monitor is given below.

(1) Connect the R.F. OUTPUT socket to the 50-ohm diode voltmeter.

(2) Set the ATTENUATOR to 100 mV ACROSS EXTERNAL LOAD.

(3) Set the frequency dial to a position about one-quarter to one-third of the total travel from the low-frequency end of the band.

At this point in the factory calibration procedure, the r.f. oscillator is adjusted so that maximum output can be obtained regardless of accuracy. This adjustment consists of (i) setting the physical position of the tuning inductors, L7 to L11, relative to the attenuator pick-up loop, and (ii) setting preset capacitor C54, between oscillator cathode and earth, for optimum output on Range E.

With some oscillator valves the anode-cathode capacitance effectively between cathode and earth is sufficient to allow an adequate r.f. output to be obtained, and that, in fact, the presence of additional capacitance tends to reduce the output level. If on replacing an oscillator valve this is found to be so, C54 should be removed. In the factory calibration of the instrument, C54 is only fitted when the need arises.

If any of the inductors have been replaced, the particular inductor must be rotated around the axis of its clamping screws until maximum output is observed on the external diode voltmeter before the clamping screws are finally tightened. Apart from a replacement inductor, it will only be necessary to reset the positions of the inductors if insufficient output can be obtained as indicated on the external voltmeter. To check this, switch to each band in turn and make sure that at least 100 mV can be obtained. If difficulty is experienced in obtaining the required output on the highest-frequency range (Range E), adjust capacitor C54 for optimum output over the whole range.

4.9.5. (continued)

(4) Set the RANGE switch to 110 - 240 Mc/s (Range D) and adjust the SET CARRIER control so that the voltmeter indicates exactly 100 mV.

(5) Adjust RV8 so that the CARRIER LEVEL meter reads at its SET CARRIER mark.

With operation (5), above, completed, RV8 should be at about mid-travel position. If it is found that the potentiometer is at or near the limit of its travel select a new value for R82.

(6) Switch to each band in turn and, if necessary, select a value for the appropriate series resistor so that the CARRIER LEVEL meter reads reads correctly when 100 mV is indicated on the external meter.

On Band:	Adjust Resistor:	On Band:	Adjust Resistor:
A	R85	D	R82
B	R84	E	R81
C	R83		

The following check must be made with the instrument in its case.

(7) Check the r.f. output level accuracy by a normal substitution method utilizing a receiver and a standardized signal generator.

The actual r.f. output level should be accurate to within 2 dB of the nominal at any frequency and at any level.

Make sure that the signal strength - as indicated by the signal-strength meter of the receiver - decreases progressively right down to 1 μV with no tendency, due to stray radiation, to increase again as the ATTENUATOR reading approaches 1 μV.

4.9.6. Coverage of SET CARRIER Control

This test should be carried out with the instrument out of its case.

Before making any adjustments to the SET CARRIER circuits, adjust the h.t. voltage level as described below.

(1) Short-circuit the EXT F.M. and earth terminals; set the INC FREQ switch to VAR; set the modulation-monitor selector to INC FREQ 20 kc/s.

4. 9. 6. (continued)

(2) Adjust RV4 so that the MODULATION AND INCREMENTAL FREQUENCY meter reads at its central zero mark.

When the r. f. level has been correctly set as described in Section 4. 9. 5, check and, if necessary, adjust the coverage of the SET CARRIER control. This is done by adjusting resistors R76 to R80 so that the setting of the SET CARRIER potentiometer required to bring the CARRIER LEVEL meter to its reference mark is approximately the same on all bands. The method is described below.

(3) Temporarily short-circuit R75.

(4) Set the RANGE switch to Band A (10 - 22 Mc/s).

(5) Set the frequency dial to a position about one-quarter to one-third of the total travel from the low-frequency end of the band.

(6) Adjust the CARRIER LEVEL meter to the SET CARRIER mark by means of the SET CARRIER control.

(7) Switch to the remaining bands in turn and, without altering the position of the SET CARRIER control, note on which band the SET CARRIER meter indication is least.

(8) Disconnect the temporary short-circuit link across R75 and, with the RANGE switch set to the band which gives the least CARRIER LEVEL indication, short-circuit the resistor appropriate to that range.

Min. Indication On Band:	Short-Circuit Resistor:
A (10 - 22 Mc/s)	R76
B (22 - 48 Mc/s)	R77
C (48 - 110 Mc/s)	R78
D (110 - 240 Mc/s)	R79
E (240 - 470 Mc/s)	R80

(9) Switch to the remaining bands in turn and, if necessary, select values for the series resistors, R76 to R80, such that the setting of the SET CARRIER control remains sensibly constant.

4.9.6. (continued)

(10) Check that, at all carrier frequencies, the CARRIER LEVEL meter can be set to its reference mark.

4.9.7. Deviation and INC FREQ - VAR Accuracy

(Apparatus Reqd: Items b, d, k, l, and m)

During the factory calibration procedure, two resistors are selected on each band in order to obtain the required deviation and variable incremental-frequency accuracy. Subsequent correction of any inaccuracy which is common to all bands can normally be effected by adjustment of preset resistors RV10 and RV11. RV10 affects both deviation and incremental frequency accuracy; RV11 affects deviation accuracy only. If, however, the error is confined to one band only, e.g., due to a faulty resistor, the procedure detailed in Section 4.9.8. should be carried out.

The procedure for adjusting RV10 and RV11 is given below.

(1) Set the RANGE switch to Band A.

(2) Connect the R.F. OUTPUT socket to the Crystal Calibrator.

(3) Connect the "Difference Frequency" output socket on the Crystal Calibrator to some suitable means of monitoring frequencies of up to 100 kc/s; e.g., diode mixer in conjunction with an a.f. oscillator and head telephones.

(4) Set the Signal Generator modulation selector to F.M.; turn the SET MOD control to minimum, the monitor selector to INC FREQ 100 kc/s, and the INC FREQ switch to VAR.

(5) Adjust the variable INC FREQ control to give zero reading on the MODULATION AND INCREMENTAL FREQUENCY meter and adjust the COARSE and FINE TUNING controls for zero beat at 15 Mc/s against the Crystal Calibrator 5-Mc/s crystal. Turn the SET MOD control to maximum then progressively back to minimum in order to neutralize any modulator hysteresis. If necessary readjust the TUNING controls.

(6) Adjust the variable INC FREQ control to give a "Difference Frequency" output of 100 kc/s. Neutralize any modulator hysteresis as in (5) above and, if necessary, readjust the INC FREQ control.

4.9.7. (continued)

If necessary, adjust RV10 to produce a minimum error at both + 100 kc/s and -100 kc/s frequency shift at carrier frequencies of 15 and 22 Mc/s.

(7) Disconnect the Crystal Calibrator and, in its place, connect the R.F. OUTPUT socket to the Carrier Deviation Meter.

(8) Set the monitor selector to MOD 0-100.

(9) Check the deviation accuracy at the extremes of the carrier frequency band.

(10) Repeat (9) above on the MOD 0-20 deviation range.

If necessary, adjust RV11 to produce deviation readings with minimum error at the extremes of the carrier frequency band. Do not alter the setting of RV10.

As the potentiometer networks preceding the modulator driver, V2, are common to both deviation and frequency shift circuits, once the deviation and incremental frequency accuracies have been adjusted on Band A it is not necessary to readjust RV11 on any of the higher-frequency bands.

(11) Repeat operations (7) to (10) above on carrier-frequency Bands B, C, D, and E.

If necessary, readjust RV10 to produce deviation readings with the lowest possible maximum error, by distributing the error over the whole of the carrier-frequency range of 10 to 470 Mc/s.

The deviation direct-reading accuracy should be within ±7% of f.s.d. up to 110 Mc/s, 10% of f.s.d. up to 240 Mc/s, and 20% of f.s.d. up to 470 Mc/s.

To check the validity of the CORRECTION CHART FOR DEVIATION AND INCREMENTAL FREQUENCY MONITOR, measure the deviation at a selection of frequencies throughout the range 110 Mc/s to 470 Mc/s; the measured value and the chart reading should agree to within ±7% at all carrier frequencies. If they do not, recalibrate the chart; to order blank replacement charts, refer to the Spares Ordering Schedule.

4. 9. 8. Selection of Deviation Correcting-Network Resistors

(Apparatus Reqd: Items b, d, i, f, k, l and m)

The tests to be described in this section should only be performed if the requirements of Section 4. 9. 7. cannot be met.

This test should be done with the instrument out of its case.

The correcting-network resistors for the f. m. deviation and monitoring circuits must be selected in the correct sequence, because (a) the same meter is used for three separate functions - viz: monitoring of a. m. depth, f. m. deviation, and incremental-frequency shift - (b) the ferrite modulation (TR1) is used for both frequency modulation and incremental-frequency shift, and (c) the resistance of the correcting network presented to the INC FREQ circuit must remain sensibly constant for optimum working.

Before commencing any adjustments to the correcting network, check that the MODULATION AND INCREMENTAL FREQUENCY meter reads at its central zero mark when the EXT MOD. F. M. and earth terminals are shorted and the monitor selector switch is set to INC FREQ 20 kc/s. If the zeroing is in error, refer to Section 4. 9. 6.

(A) Adjustments on Band A (10 - 22 Mc/s)

Deviation Accuracy

(1) Set the RANGE switch to Band A.

(2) Disconnect resistors R10 and R11 and connect in their places the two variable resistors.

(3) Connect the R. F. OUTPUT socket to the carrier deviation meter.

(4) Set the modulation selector to INT F. M., the MOD FREQ switch to 1 kc/s, and the mod. monitor selector to MOD 0 - 100.

(5) Adjust the SET MODULATION control to give a deviation of approximately 100 kc/s as indicated on the carrier deviation meter.

(6) By successive adjustment of the two variable resistors, obtain a correct reading for carrier deviation over the carrier range 10 to 22 Mc/s.

4.9.8. (continued)

R11 affects the 22-Mc/s end of the band more than the 10 Mc/s end, and R10 affects the whole of the band more or less equally. The deviation accuracy should be within ±7% of f.s.d. over the whole band.

Incremental Frequency Accuracy

(7) Disconnect the carrier deviation meter and connect the R.F. OUTPUT socket to the crystal calibrator.

(8) Connect the "Difference Frequency" output socket on the Crystal calibrator to some suitable means of monitoring frequencies of up to 100 kc/s; e.g., diode mixer in conjunction with a.f. oscillator and head telephones.

(9) Set the Signal Generator modulation selector to C.W., the monitor selector to INC FREQ 100 kc/s, and the INC FREQ switch to VAR.

(10) Adjust the variable INC FREQ control to give zero reading on the MODULATION AND INCREMENTAL FREQUENCY meter and tune the frequency controls for zero beat at 15 Mc/s against the Crystal Calibrator 5-Mc/s crystal.

(11) Adjust the variable INC FREQ control to give a "Difference Frequency" output of 100 kc/s.

If necessary, adjust the variable resistor which is temporarily replacing R10 to produce minimum error at both + 100 kc/s and - 100 kc/s frequency shift at carrier frequencies of 15 and 22 Mc/s.

General Accuracy

(12) Reconnect the R.F. OUTPUT socket to the Carrier Deviation Meter.

(13) Set the monitor selector to MOD 0-100.

(14) Check the deviation accuracy at the extremes of the carrier frequency band.

If necessary, adjust RV11 to produce deviation readings with negligible error at the extremes of the carrier frequency band. Do not alter the settings of the two variable resistors.

4.9.8. (continued)

(15) Set the monitor-selector switch to MOD 0-20.

(16) Check the deviation accuracy at the extremes of the carrier frequency band.

If necessary, select a value for R44 to produce deviation readings with negligible error at the extremes of the carrier frequency band. Do not alter the settings of the two variable resistors.

(17) Measure the resistances of the two variable resistors and replace them with fixed resistors of the same values.

The deviation accuracy should be within ±7% of f.s.d., and the incremental-frequency accuracy within ±10% of f.s.d., at all carrier frequencies within the range 10 to 22 Mc/s.

(B) Adjustments on Band B (22 - 48 Mc/s)

(18) Set the RANGE switch to Band B.

(19) Disconnect resistors R9 and R59 and connect in their places the two variable resistors.

(20) Carry out a procedure similar to that described in (3) to (6) under part (A) of this section.

R59 affects the 48-Mc/s end of the band more than the 22-Mc/s end, and R9 affects the whole of the band more or less equally. The deviation accuracy should be within ±7% of f.s.d. over the whole of the band.

(21) Measure the resistances of the two variable resistors and replace them with fixed resistors of the same values.

(C) Adjustments on Band C (48 - 110 Mc/s)

(22) Set the RANGE switch to Band C.

(23) Disconnect resistors R8 and R48 and connect in their places the two variable resistors.

4.9.8. (continued)

(24) Carry out a procedure similar to that described in (3) to (6) under part (A) of this section.

R48 affects the 110-Mc/s end of the band more than the 48-Mc/s end, and R8 affects the whole of the band more or less equally. The deviation accuracy should be within ±7% of f.s.d. over the whole of the band.

(25) Measure the resistance of the two variable resistors and replace them with fixed resistors of the same values.

(D) Adjustments on Band D (110 - 240 Mc/s)

(26) Set the RANGE switch to Band D.

(27) Disconnect resistors R7 and R51 and connect in their places the two variable resistors.

(28) Carry out a procedure similar to that described in (3) to (6) under part (A) of this section.

R51 affects the 240-Mc/s end of the band more than the 110-Mc/s end, and R7 affects the whole of the band more or less equally.

(29) Measure the resistance of the two variable resistors and replace them with fixed resistors of the same values.

(30) Check the deviation accuracy at a selection of frequencies throughout the band and insert the correction figures obtained on the CORRECTION CHART FOR DEVIATION AND INCREMENTAL FREQUENCY MONITOR. To order blank replacement charts, refer to the Spares Ordering Schedule. The direct-reading accuracy should be generally within ±7% at all carrier frequencies.

(E) Adjustments on Band E (240 - 470 Mc/s)

(31) Set the RANGE switch to Band E.

(32) Disconnect resistors R6 and R50 and connect in their places the two variable resistors.

(33) Carry out a procedure similar to that described in (3) to (6) under part (A) of this section.

4. 9. 8. (continued)

R50 affects the 470-Mc/s end of the band more than the 240-Mc/s end, and R6 affects the whole of the band more or less equally.

(34) Measure the resistance of the two variable resistors and replace them with fixed resistors of the same values.

(35) Check the deviation accuracy at a selection of frequencies throughout the band and insert the correction figures obtained on to the CORRECTION CHART FOR DEVIATION AND INCREMENTAL FREQUENCY MONITOR. To order blank replacement charts, refer to the Spares Ordering Schedule. The direct-reading accuracy should be within ±20% at all carrier frequencies.

4. 9. 9. Switched INC FREQ Accuracy (Apparatus Reqd: Items b, d, l, and m)

This test should be done with the instrument out of its case.

The continuously-variable incremental frequency accuracy is set up during the adjustments on the f. m. deviation. The switched INC FREQ control, however, has to be adjusted separately as the actual shift is not indicated on the MODULATION AND INCREMENTAL FREQUENCY meter.

So that the shift is as near constant as possible over the whole of the carrier frequency band, the impedance presented to the incremental-frequency circuit, R60 to R69, by the f. m. input potential divider, LEAD 2 to chassis on TLC 23313, must remain substantially level at all carrier frequencies. This is achieved as described below.

(1) Set the frequency dial to a position about one-quarter to one-third of the total travel from the low-frequency end of the band.

(2) Set up the Signal Generator for 60-kc/s internal f. m. at a modulation frequency of 1 kc/s.

(3) Switch to each carrier frequency band in turn and, without altering the position of the SET MODULATION control, note on which band the modulation monitor indication is least.

(4) On this band adjust the SET MODULATION control so that the meter reads at 60 kc/s deviation.

4.9.9. (continued)

(5) On the remaining bands adjust the f.m. potentiometer shunt resistors, R70 to R74, so that the meter reads at 60 kc/s for the setting of the SET MODULATION control obtained in (4) above.

On Band:	Adjust Resistor:
A (10 - 22 Mc/s)	R70
B (22 - 48 Mc/s)	R71
C (48 - 110 Mc/s)	R72
D (110 - 240 Mc/s)	R73
E (240 - 470 Mc/s)	R74

The accuracy of the switched INC FREQ control can now be set up as described below.

(6) Connect the R.F. OUTPUT socket to the Crystal Calibrator.

(7) Connect the "Difference Frequency" output socket on the Crystal Calibrator to some suitable means of monitoring frequencies of up to 15 kc/s; e.g. diode mixer in conjunction with a.f. oscillator and head telephones.

(8) Set the Signal Generator modulation selector to C.W. and the INC FREQ switch to its central zero position.

(9) Set the RANGE control to Band A and tune the frequency controls for zero beat at 10 Mc/s against the Crystal Calibrator 5-Mc/s crystal.

(10) Switch to the INC FREQ -5 kc/s, -10 kc/s, and -15 kc/s settings in turn and check the actual frequency shift.

If necessary, select a new value for R60 so that the incremental shift accuracy is within ±10% on all three switch positions.

(11) Switch to the INC FREQ +5 kc/s, +10 kc/s, and +15 kc/s settings in turn and check the actual frequency shift.

If necessary, select a new value for R69 so that the incremental shift accuracy is within ±10% on all three switch positions.

4.9.10. External F.M. Characteristic (Apparatus Reqd: Items d and k)

This test can be done with the instrument in or out of its case.

Check the frequency characteristic of the EXT F.M. input circuit in the following manner.

(1) Connect the R.F. OUTPUT socket to the carrier deviation meter.

(2) Set the RANGE switch to Band A and the frequency controls to 16 Mc/s.

(3) Set the modulation selector to EXT F.M. and the modulation monitor selector to MOD 0 - 100.

(4) Connect the a.f. oscillator to the EXT F.M. and earth terminals; its frequency to 1000 c/s and adjust its output to produce a carrier deviation of 60 kc/s.

(5) Keep the a.f. input voltage constant and check the Signal Generator meter reading against the Carrier Deviation Meter indication over the modulating frequency range 30 c/s to 15 kc/s.

The a.f. input voltage required to produce 100 kc/s deviation should not exceed 25 volts at 1000 c/s. The variation in required input level should not exceed 10% relative to the reading at 1000 c/s; and the error in the Signal Generator deviation indication should not exceed 5% of full-scale deflection at all modulation frequencies.

If the frequency characteristic is in error, correction can be effected by adjustment of R26, the resistor connected across the ferrite modulator, TR1.

4.9.11. A.M. Calibration Accuracy (Apparatus Reqd: Items c and h)

This test should be done with the instrument in its case.

Check the accuracy of the amplitude-modulation indicator in the following manner.

(1) Connect the R.F. OUTPUT socket to the input of the receiver.

4. 9. 11. (continued)

(2) Connect the "I. F. Output" of the Receiver to the "Y Input" of the Oscilloscope.

(3) Set the RANGE switch to Band A, the frequency controls to 10 Mc/s, and the modulation selector to C. W.

(4) Adjust the receiver tuning to give maximum deflection of the c. r. o. beam and, by means of the ATTENUATOR control, adjust the r. f. level to produce a display of convenient amplitude.

(5) Set the modulation selector to INT A. M. and the monitor selector to MOD 0 - 100.

(6) Adjust the SET MODULATION control to give 40% modulation depth as measured on the oscilloscope screen by the use of the formula

$$M(\%) = \frac{D_{max} - D_{min}}{D_{max} + D_{min}} \times 100$$

where D_{max} is the peak-to-peak dimension of the c. r. o. display and D_{min} is the trough-to-trough dimension of the c. r. o. display. If necessary, adjust RV7 to bring the meter indication to exactly 40%.

If it is found that the required setting for RV7 is at or near the limit of its travel, set RV7 to mid-position and adjust R39 to bring the meter indication to about 40%; finally, adjust the meter reading by means of RV7.

(7) Check the scale shape of the monitor meter on both its 0 - 100 and 0 - 20 scales up to 40% modulation; the maximum permitted error is 5% modulation on the 0 - 100 scale and 2% modulation on the 0 - 20 scale. If necessary, readjust RV7 to a position where the calibration is within the above tolerances at all modulation depths.

4. 9. 12. External A. M. Characteristic (Apparatus Reqd: Items c, d, and h)

This test can be done with the instrument out of its case.

Check the frequency characteristic of the EXT A. M. input circuit in the following manner.

(1) Connect the R. F. OUTPUT socket to the input of the Receiver.

4. 9. 12. (continued)

(2) Connect the "I. F. Output" of the Receiver to the "Y Input" of the Oscilloscope.

(3) Set the RANGE switch to Band A and the frequency control to 16 Mc/s.

(4) Set the modulation selector to EXT A. M. and the modulation monitor to MOD 0-100.

(5) Connect the a. f. oscillator to the EXT MOD A. M. and earth terminals; set its frequency to 1000 c/s and adjust its output level to produce a modulation depth of 40%.

(6) Tune the Receiver for maximum display amplitude on the Oscilloscope.

(7) Keep the a. f. input voltage constant and check the Signal Generator meter reading against the oscilloscope indication over the modulating frequency range 30 c/s to 15 kc/s.

The a. f. input voltage required to produce 40% modulation should not exceed 10 volts at 1000 c/s. The variation in required input level should not exceed 1 dB relative to the reading at 1000 c/s; and the error in the Signal Generator modulation depth indication should not exceed 5% modulation at any modulation frequency.

If the frequency characteristic is in error, correction can be effected by adjustment of C46 and/or C50, in the cathode line of the a. f. amplifier V9A.

4. 9. 13. Hysteresis of the Ferrite Modulator (Apparatus Reqd: Item b)

This test should be done with the instrument in its case.

Check the degree to which the hysteresis effect of the ferrite modulation affects the INC FREQ accuracy in the following manner.

(1) Connect the R. F. OUTPUT socket to the Crystal Calibrator.

(2) Set the RANGE switch to Band A and the frequency controls to 15 Mc/s.

4. 9. 13. (continued)

(3) Set the modulation selector to INT F. M. and the monitor selector to INC FREQ 100 kc/s.

(4) With the SET MODULATION control fully counter-clockwise and the INC FREQ kc/s switch at VAR, adjust the INC FREQ control to bring the meter reading to its central zero position.

(5) Turn the SET MODULATION control fully clockwise and then slowly back to zero in order to neutralize the hysteresis of the ferrite modulator. If necessary, readjust the INC FREQ meter zero.

(6) Tune the Signal Generator for zero beat against the 5-Mc/s crystal of the Crystal Calibrator.

(7) Turn the INC FREQ control to produce 100 kc/s shift and then back to the zero-beat position.

The change in meter indication after this operation is due to hysteresis and should not exceed 5 kc/s. If the change is greater than 5 kc/s, then a faulty ferrite modulator, TR1, is indicated. The amounts by which the change exceeds 5 kc/s and the accuracy required by the user will determine whether or not this component need be changed.

4. 9. 14. Spurious F. M. on C. W. (Apparatus Reqd: Items f and k)

This test should be done with the instrument in its case.

Any spurious f. m. content of a c. w. output signal is due mainly to hum at the r. f. oscillator valve; this spurious modulation can be minimized by the adjustment of the HUM ADJUST control. With this control, it should be possible to reduce the spurious f. m. to a value less than 100 c/s deviation at all carrier frequencies. To check that this can be done, the test detailed in the following paragraphs should be carried out.

(1) Connect the R. F. OUTPUT socket to the Carrier Deviation Meter.

Note that since the deviation to be measured is as low as 100 c/s, it is essential that the Deviation Meter itself generates negligible spurious f. m. This can be achieved either by modifying the deviation meter to operate from batteries or by using a deviation meter whose local oscillator can be brought under crystal control.

4. 9. 14. (continued)

(2) In order to detect the small amount of deviation accurately, connect the Wave Analyser to the "L. F. Output" terminals of the Carrier Deviation Meter.

(3) Set up the Signal Generator for, say, 10 kc/s internal f. m. deviation at a carrier frequency of 10 Mc/s.

(4) Peak the Wave Analyser reading by tuning the Deviation Meter in the normal manner for a 10-Mc/s input and by tuning the Wave Analyser to the modulating frequency. From this reading, the Wave Analyser can be calibrated in terms of mV per kc/s deviation.

(5) Set the modulation selector to C. W. and, with the Carrier Deviation Meter still tuned to the 10-Mc/s carrier frequency, tune the Wave Analyser to the frequency of the power supply.

(6) Adjust the HUM ADJUST control until the Wave Analyser indication is at a minimum.

(7) Measure the levels of the hum and ripple modulating components and, from the geometric sum, calculate the deviation. The deviation should be less than 100 c/s.

(8) Repeat operations (5), (6), and (7) for a selection of frequencies up to 470 Mc/s. In all cases, the deviation should be less than 100 c/s.

If the spurious f. m. cannot be reduced to a value less than 100 c/s at all carrier frequencies, and if a low value of spurious f. m. is of prime importance, then it will be necessary to replace V2 or, more occasionally, V6.

The second form of spurious f. m. is due to microphony. During the factory calibration procedure, the microphony is checked by means of a 50-c/s transducer unit which is bolted to the Signal Generator frame.

It is difficult to specify a standard transducer for this purpose, but a good substitute is to connect the Signal Generator to the Carrier Deviation Meter, and then to give the Signal Generator front panel a sharp, hard rap with the knuckle. The transient deviation caused by this action should not exceed 10 kc/s.

APPENDICES

VALVE REPLACEMENT DATA ..... VRD 1066A

COMPONENT LAYOUT ILLUSTRATIONS
- Front View ..... MP 1066A-1
- Rear View ..... MP 1066A-2
- Top View ..... MP 1066A-3
- L.F. and Power Unit (Front View) ..... MP 1066A-4
- L.F. and Power Unit (Rear View) ..... MP 1066A-5
- R.F. Unit ..... MP 1066A-6

SPARES ORDERING SCHEDULE WITH CIRCUIT REFERENCES SOS/1066A

FUNCTIONAL DIAGRAM ..... TLC 28312

CIRCUIT DIAGRAM OF R.F. UNIT ..... TLC 28313

CIRCUIT DIAGRAM OF L.F. UNIT ..... TLC 28314

TEST CIRCUITS ..... TLB 28315

DECIBEL CONVERSION TABLE ..... OM G-SUPP dB

AMENDMENT SHEET No. AM 275/1

Operating and Maintenance Handbook

for

F.M. SIGNAL GENERATOR

TYPE TF 1066A

Valve Replacement Data Sheet No. 2

Valve V6 is now a Mullard Type TD03-10.

Illustration No. MP 1066A-6

The components on the tagboard in the Underside View have been rearranged slightly, to form a neater layout. The components are, however, in the same order as the arrangement of the numbered annotations.

One Sheet

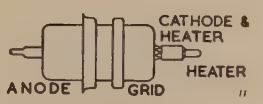
Valve Replacement Data

for

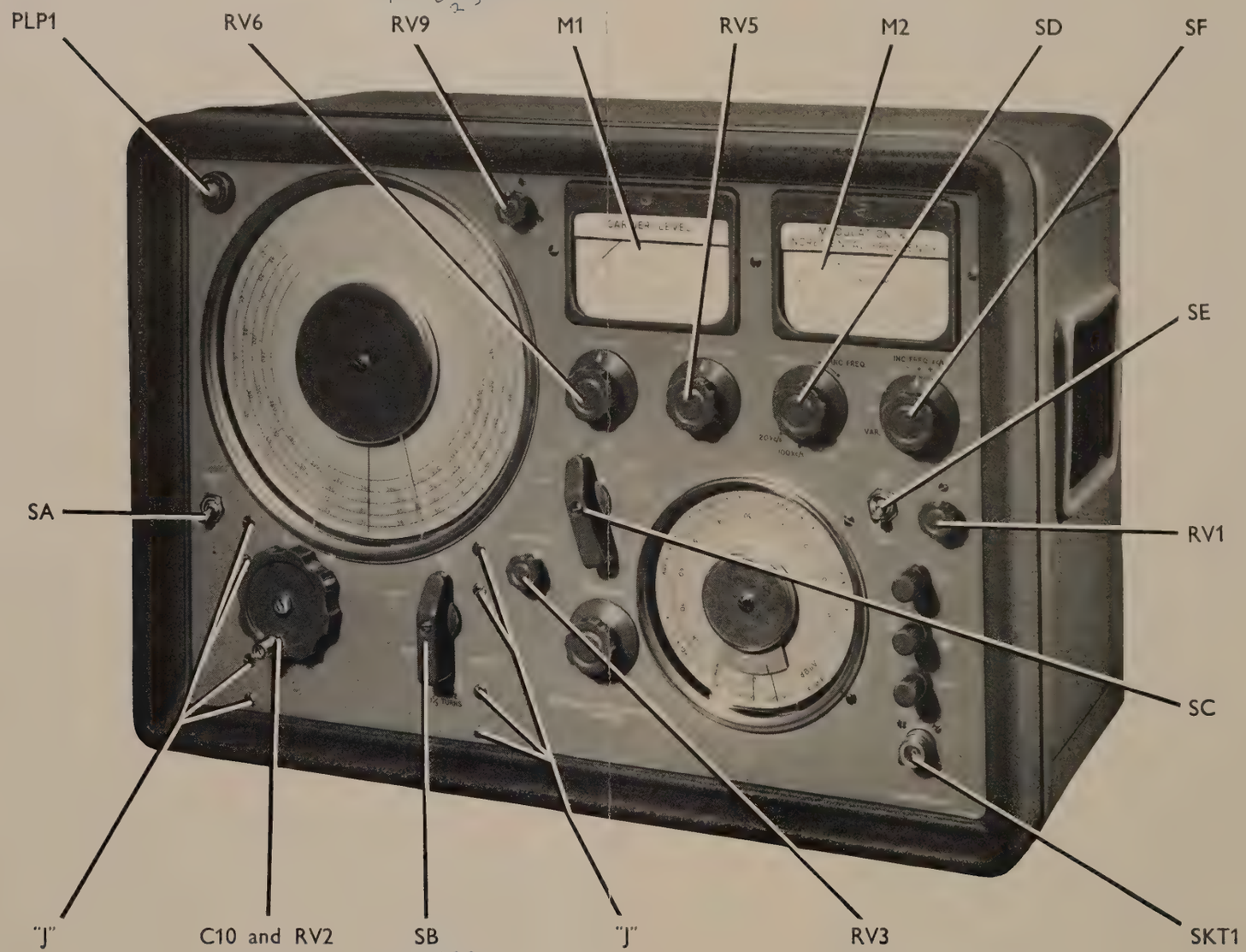
F.M. SIGNAL GENERATOR TYPE TF 1066A

Any valve which becomes faulty should preferably be replaced by a valve of the type originally supplied in the instrument and designated in the following table. If this is not possible, the additional data given by the table may be used as a guide to suitable alternatives.

Valve	*British Commercial Equivalent*	*British Services Equivalent*	*Base*	*U.S. Equivalent*
V1 FULL-WAVE RECTIFIER BRIMAR 5Z4G		CV1863	INTERNATIONAL OCTAL	5Z4G
V2 POWER PENTODE BRIMAR 6AK6		CV1762	MINIATURE 7-PIN (B7G)	6AK6
V3 TETRODE BRIMAR 6CD6G			INTERNATIONAL OCTAL	6CD6G
V4 PENTODE BRIMAR 6AK5	EF95	CV850	MINIATURE 7-PIN (B7G)	6AK5

Valve	*British Commercial Equivalent*	*British Services Equivalent*	*Base*	*U.S. Equivalent*
V5 VOLTAGE STABILIZER MULLARD 85A2	QS1209 QS83/3	CV449 CV2573	MINIATURE 7-PIN (B7G) 	5651
V6 DISC SEAL TRIODE MARCONI DET22	TDO3–10	CV273	SPECIAL 	5861
V7 TRIODE MARCONI L77	EC90	CV133	MINIATURE 7-PIN (B7G) 	6C4
V8 TETRODE MARCONI KT66		CV1947	INTERNATIONAL OCTAL 	6L6G
V9 DOUBLE TRIODE BRIMAR 12AX7	ECC83 B339	CV492	MINIATURE 9-PIN (B9A) 	12AX7

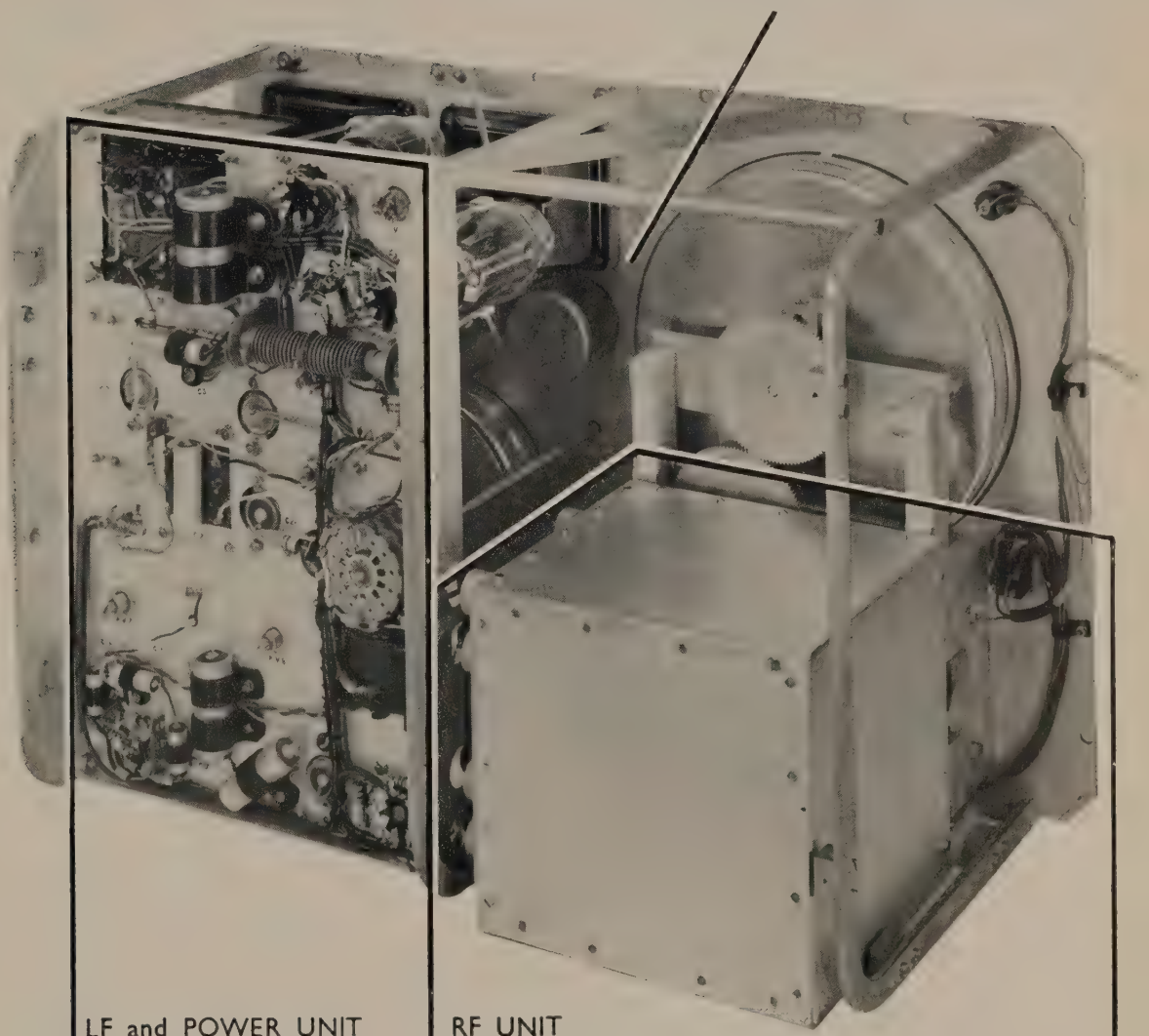
Valve	*British Commercial Equivalent*	*British Services Equivalent*	*Base*	*U.S. Equivalent*
V10 VOLTAGE STABILIZER BRIMAR 0B2	108C1 QS1208		MINIATURE 7-PIN (B7G) 	0B2
V11, V12 BARRETTER HIVAC XB1	UD143	CV2293	MINIATURE 7-PIN (B7G) 	


PLP1
RV6
RV9
M1
RV5
M2
SD
SF
SE
SA
RV1
SC
"J"
C10 and RV2
SB
"J"
RV3
SKT1

FRONT VIEW

C.P. 4c. 4/60

For details of rear of FRONT PANEL see MP 1066A—3

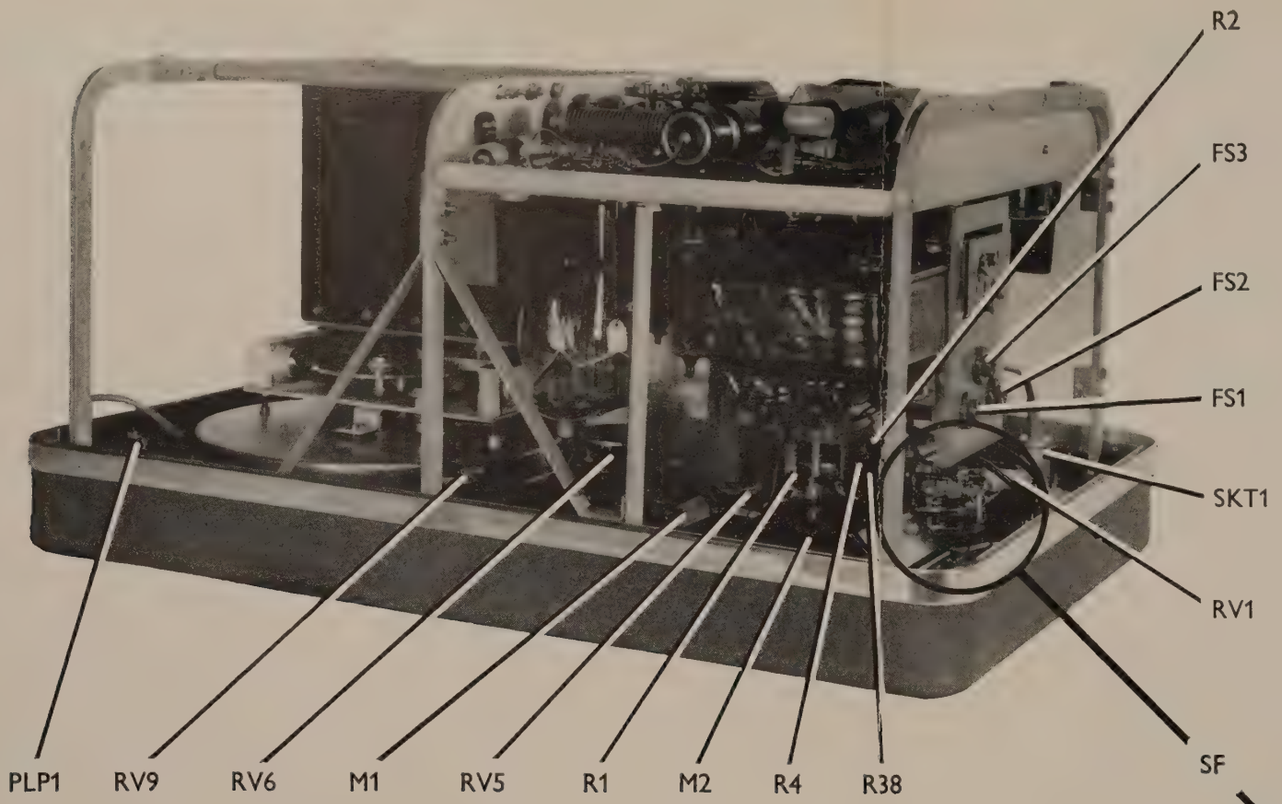


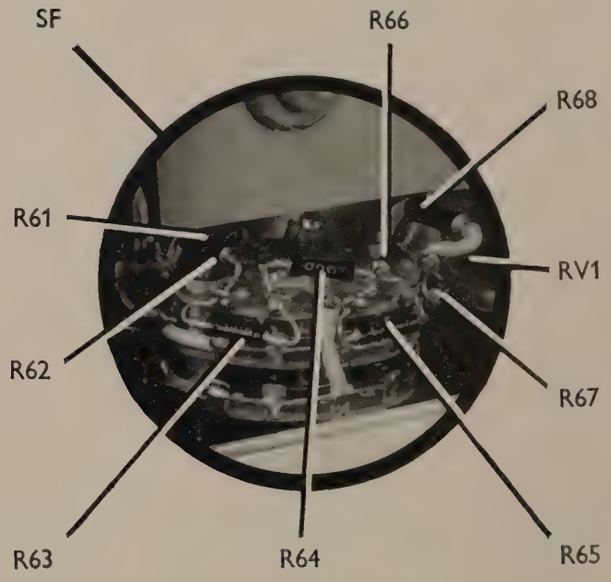
LF and POWER UNIT
for details see MP 1066A—4
and MP 1066A—5

RF UNIT
for details see MP 1066A—6

M.I. LTD. 1—5 58

GENERAL VIEW
FROM REAR

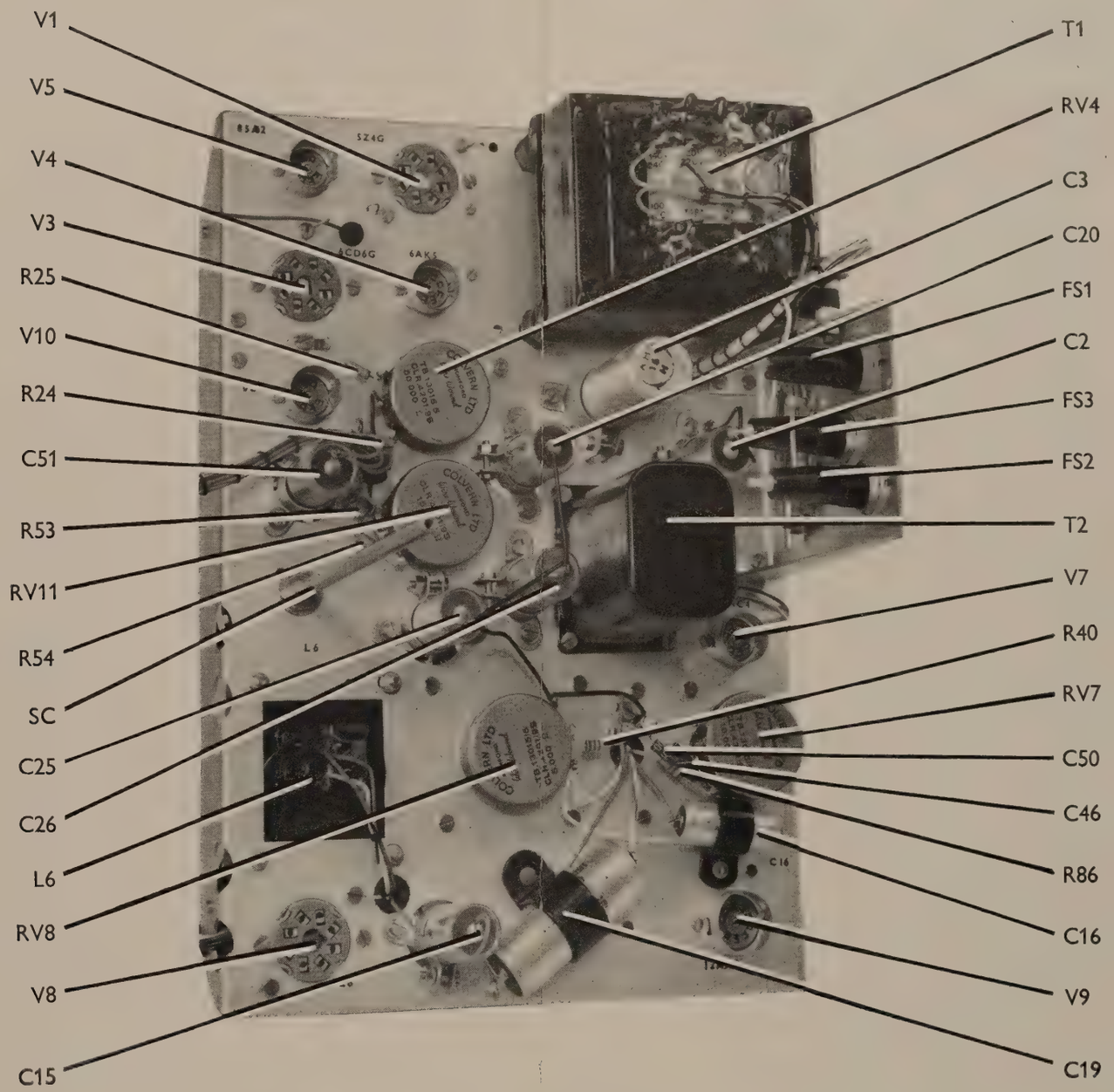




TOP
REAR VIEW

M.I. LTD. 1—5/58

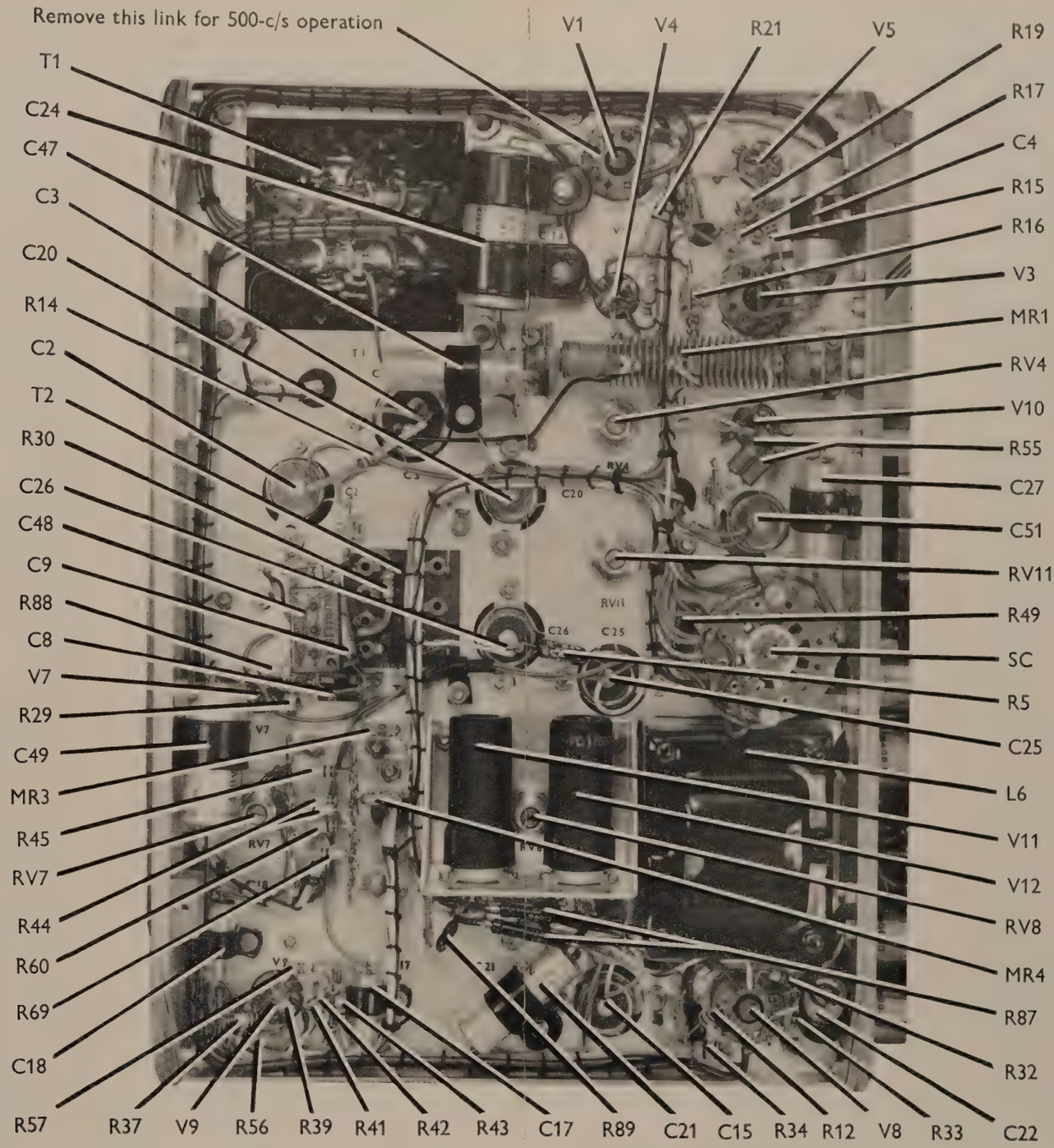
C.P. 4c. 4/60



LF AND POWER UNIT
FRONT VIEW

M.I. LTD. 1—5 58

C.P. 4c. 4,60



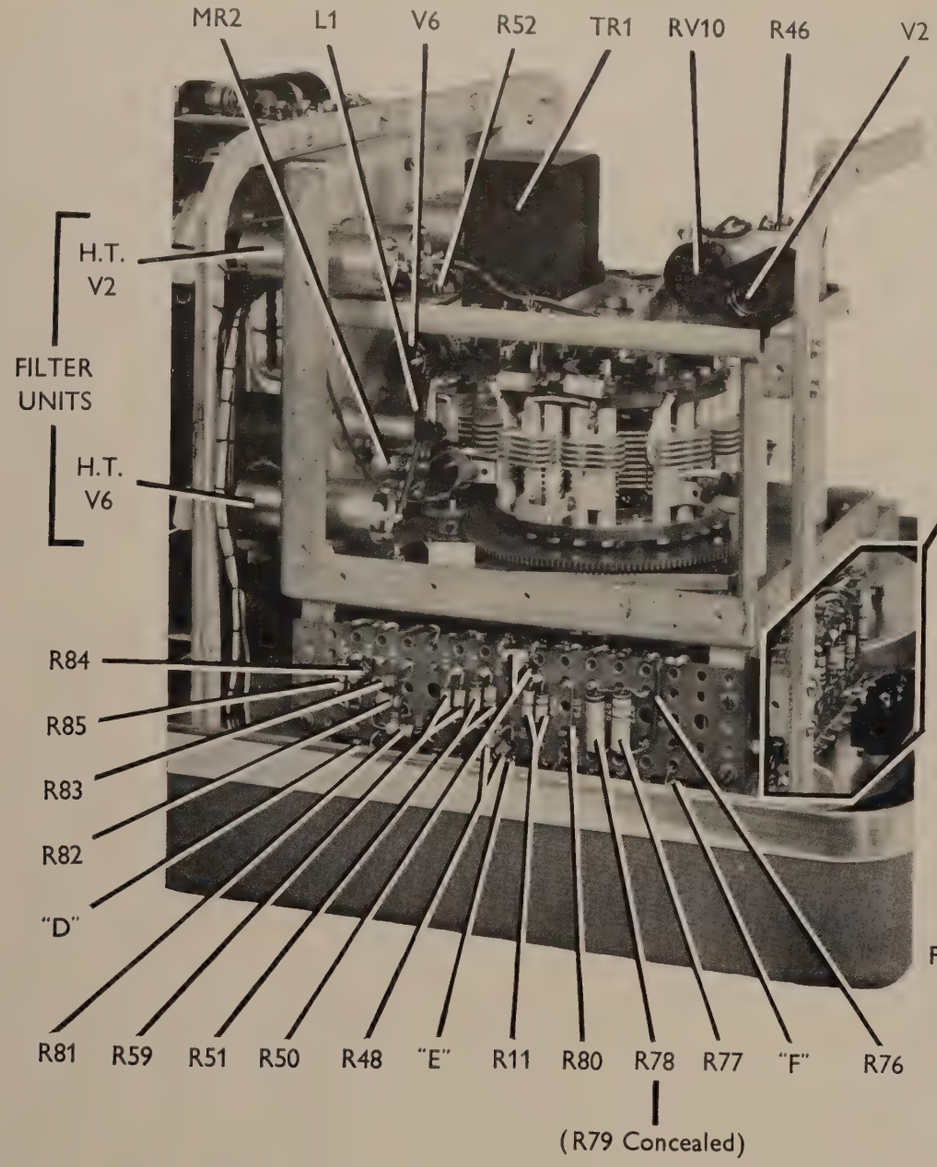
Capacitor C27 is now mounted between C20 and C26. The space formerly occupied by C27 is used to accommodate three additional components: inductor L24 and capacitors C52 and C53.

An additional component, TH1, is situated near R89.

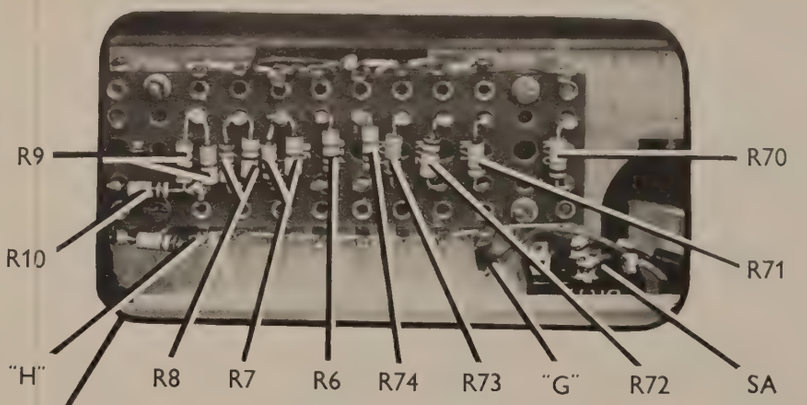
LF AND POWER UNIT
REAR VIEW

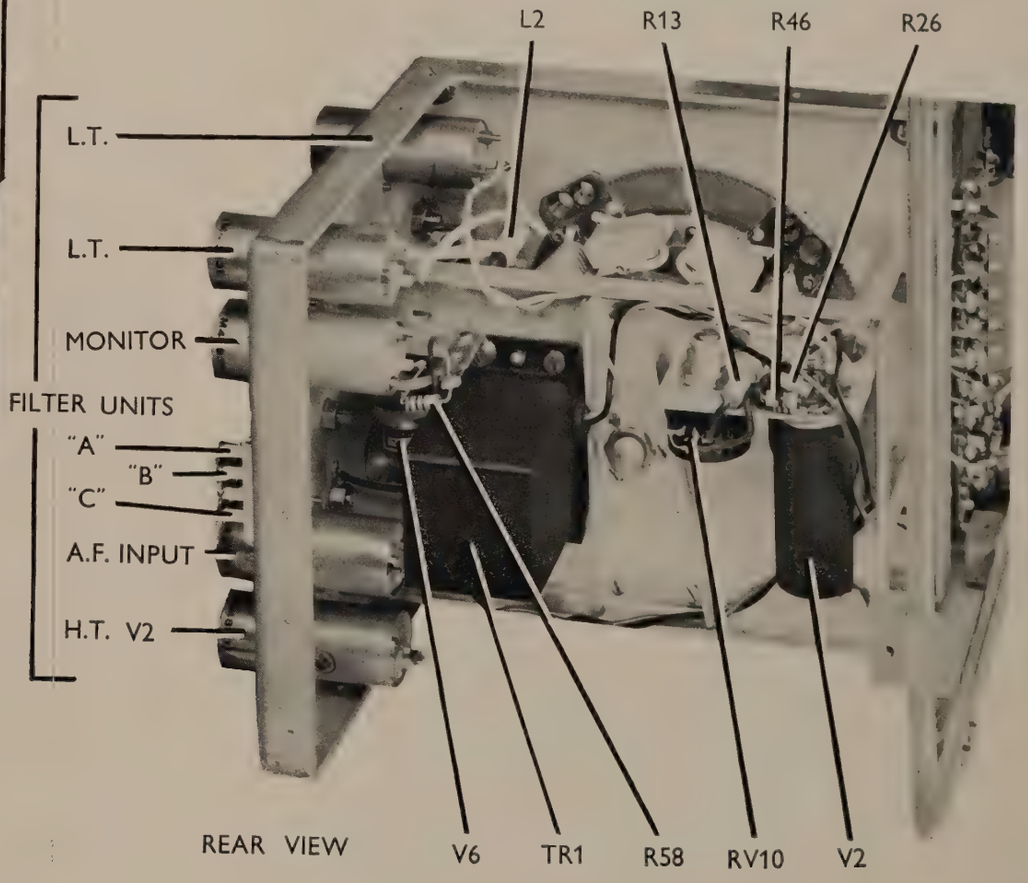
M.I. LTD. 1—5/58

C.P. 4c. 4/60



UNDERSIDE VIEW





REAR VIEW

R26 is now mounted on an insulated tag which is held by one of the fixing screws at the base of TR1.

R.F. UNIT

M.I. LTD. 1—5 58

C.P. 4c. 4/60

SPARES ORDERING SCHEDULE No. SOS/1066A

WITH CIRCUIT REFERENCES

F.M. SIGNAL GENERATOR TYPE TF 1066A

Applicable to Instruments Serial Nos:-

5237001 to 5237100
5326001 to 5326100
JA.191/001 to JA.191/200
JA 275/001 to JA 275/200

When ordering replacement parts, ALWAYS QUOTE THE TYPE NUMBER AND SERIAL NUMBER OF THE INSTRUMENT CONCERNED.

To specify the individual parts required, STATE FOR EACH PART THE QUANTITY REQUIRED AND THE APPROPRIATE SOS ITEM NO.

For example, to order replacements for the 10-kΩ resistor, R3, and the 1-μμF capacitor, C5, quote as follows:-

Spares for TF 1066A, Serial No. 0000000

1 off, SOS Item 3
1 off, SOS Item 103

It is important that the distinguishing code "SOS" preceding each item number should not be omitted.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		FIXED RESISTORS	
1	R1	Composition, 43 kΩ ±5%, ½W, two in parallel.	13-TF 1066
2	R2	Composition, 5.6 MΩ ±2%, 3/4W.	14-TF 1066
3	R3	Composition, 10 kΩ ±5%, ½W, included in Item 252.	4-TM 5279
4	R4	High-Stability, 120 kΩ ±2%, 1/4W.	16-TF 1066
5	R5	Wire-Wound, 4.7 kΩ ±5%, 3W.	PC 67008/17
6	R6	Composition, 1/4W, value selected in test.	
7	R7	Composition, 1/4W, value selected in test.	
8	R8	Composition, 1/4W, value selected in test.	
9	R9	Composition, 1/4W, value selected in test.	
10	R10	Composition, 1/4W, value selected in test.	
11	R11	Composition, 1/4W, value selected in test.	
12	R12	Composition, 10 Ω ±10%, ½W.	PC 66611/1
13	R13	Composition, 3.3 kΩ ±10%, ½W.	PC 66611/31
14	R14	Composition, 1 kΩ ±10%, 1/4W.	PC 66609/19
15	R15	Composition, 100 Ω ±10%, 1/4W.	PC 66609/7
16	R16	Composition, 4.7 kΩ ±10%, 1/4W.	PC 66609/27
17	R17	Composition, 680 kΩ ±10%, 1/4W.	PC 66609/53
18	R18	Composition, 330 kΩ ±10%, 1/4W.	PC 66609/49
19	R19	Composition, 47 kΩ ±10%, 1/4W.	PC 66609/39

SOS Item No.	Circuit Ref.	Description	Works Ref.
		FIXED RESISTORS (continued)	
20	R21	Composition, 100 kΩ ±10%, ½W.	PC 66611/49
21	R22	High Stability, 480 kΩ ±2%, 1/4W.	20-TF 1066
22	R23	Composition, 330 Ω ±10%, 1/4W.	PC 66609/13
23	R24	Composition, 100 kΩ ±10%, 1/4W.	PC 66609/43
24	R25	Composition, 33 kΩ ±10%, 1/4W.	PC 66609/37
25	R26	Composition, 330 kΩ* ½W.	PC 66611/55
26	R27	Composition, 10 kΩ ±10%, 1/4W.	PC 66609/31
27	R28	Composition, 2.2 kΩ ±10%, 1/4W.	PC 66609/23
28	R29	Composition, 220 kΩ ±10%, 1/4W.	PC 66609/47
29	R30	Composition, 2.2 kΩ ±10%, 1/4W.	PC 66609/23
30	R31	Composition, 47 Ω ±5%, 1/4W.	19-TM 4819/1
31	R32	Composition, 100 Ω ±10%, 1/4W.	PC 66609/7
32	R33	Composition, 1 MΩ ±10%, 1/4W.	PC 66609/55
33	R34	Composition, 1 kΩ ±10%, ½W.	PC 66611/25
34	R35	Composition, 47 Ω ±5%, 1/4W.	19-TM 4819/1
35	R36	Composition, 15 kΩ ±10%, 1W.	PC 66621/39
36	R37	Composition, 1 MΩ ±10%, 1/4W.	PC 66609/55
37	R38	Composition, 70 MΩ ±20%, 1/8W.	21-TF 1066

* Nominal value; actual value determined during calibration.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		FIXED RESISTORS (continued)	
38	R39	Composition, 100 kΩ*, 1/4W.	PC 66609/48
39	R40	Composition, 1.2 kΩ ±10%, 1/4W.	PC 66609/20
40	R41	Composition, 470 Ω ±10%, 1/4W.	PC 66609/15
41	R42	Composition, 33 kΩ ±10%, ½W.	PC 66611/43
42	R43	Composition, 1 MΩ ±10%, 1/4W.	PC 66609/55
43	R44	Composition, 15 kΩ*, 1/4W.	PC 66609/33
44	R45	Composition, 100 kΩ*, 1/4W.	PC 66609/43
45	R46	Composition, 10 Ω ±10%, 1/4W.	18-TM 5067/1
46	R47	Composition, 470 Ω ±10%, 1/4W.	PC 66609/15
47	R48	Composition, 1/4W, value selected in test.	
48	R49	Wire Wound, 2.2 kΩ ±5%, 3W.	PC 67008/15
49	R50	Composition, 1/4W, value selected in test.	
50	R51	Composition, 1/4W, value selected in test.	
51	R52	Composition, 1 MΩ ±10%, 1/4W.	PC 66609/55
52	R53	Composition, 56 kΩ ±5%, 1/4W.	85-TM 5066/1
53	R54	Composition, 15 kΩ ±5%, 1/4W.	86-TM 5066/1
54	R55	Composition, 3 kΩ ±5%, ½W, two in parallel.	44-TM 5066/1

* Nominal value; actual value determined during calibration.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		FIXED RESISTORS (continued)	
55	R56	Composition, 4.7 kΩ ±10%, 1/4W.	PC 66609/53
56	R57	Composition, 4.7 kΩ ±10%, 1/4W.	PC 66609/53
57	R58	Composition, 100 Ω ±10%, 1/4W.	PC 66609/7
58	R59	Composition, 1/4W, value selected in test.	
59	R60	Composition, 6.8 kΩ*, 1/4W.	PC 66609/29
60	R61	High Stab. 15 kΩ ±5%, ½W, included in Item 252.	6-TM 5279
61	R62	High Stab. 1.2 kΩ ±2%, 1/4W, included in Item 252.	7-TM 5279
62	R63	High Stab. 1.05 kΩ ±2%, 1/4W, included in Item 252.	8-TM 5279
63	R64	High Stab. 900 Ω ±2%, 1/4W, included in Item 252.	9-TM 5279
64	R65	High Stab. 630 Ω ±2%, 1/4W, included in Item 252.	10-TM 5279
65	R66	High Stab. 650 Ω ±2%, 1/4W, included in Item 252.	11-TM 5279
66	R67	High Stab. 670 Ω ±2%, 1/4W, included in Item 252.	12-TM 5279
67	R68	High Stab. 15 kΩ ±5%, ½W, included in Item 252.	6-TM 5279
68	R69	Composition, 6.8 kΩ*, ½W.	PC 66609/29

* Nominal value; actual value determined during calibration.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		FIXED RESISTORS (continued)	
69	R70	Composition, 1/4W, value selected in test.	
70	R71	Composition, 1/4W, value selected in test.	
71	R72	Composition, 1/4W, value selected in test.	
72	R73	Composition, 56 kΩ*, 1/4W.	PC 66609/40
73	R74	Composition, 1/4W, value selected in test.	
74	R75	Wire Wound, 15 kΩ ±10%, 10W.	12-TM 5071/1
75	R76	Composition, ½W, value selected in test.	
76	R77	Composition, ½W, value selected in test.	
77	R78	Composition, 1W, value selected in test.	
78	R79	Composition, 1W, value selected in test.	
79	R80	Composition, ½W, value selected in test.	
80	R81	Composition, 1/4W, value selected in test.	
81	R82	Composition, ½W, value selected in test.	
82	R83	Composition, 1/4W, value selected in test.	
83	R84	Composition, 1/4W, value selected in test.	
84	R85	Composition, 1/4W, value selected in test.	
85	R86	Composition, 2.2 kΩ ±10%, 1/4W.	PC 66609/23
86	R87	Composition, 240 Ω ±5%, 3/4W.	32-TM 5066/1

* Nominal value; actual value determined during calibration.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		FIXED RESISTORS (continued)	
87	R88	Composition, 47 kΩ ±10%, 1/4W.	PC 66609/39
88a	R89	Composition, 5 Ω ±10%, 3W.	105-TM 5066/2
		VARIABLE RESISTORS	
89	RV1	50 kΩ, 1W, Linear.	TB 13015/2
90	RV2	5 kΩ, 3W, Inverse Semi-Log.	12-TM 5067
91	RV3	500 Ω, 1W, Linear.	TB 13015/2
92	RV4	50 kΩ, 1W, Linear.	TB 13015/5
93	RV5	10 kΩ, 1W, Semi-Log.	TB 17392/8
94	RV6	22 kΩ, 7:5W, Linear.	12-TF 1066
95	RV7	10 kΩ, 1W, Linear.	TB 13015/5
96	RV8	5 kΩ, 1W, Linear.	TB 13015/5
97	RV9	15 kΩ, 2W, Linear.	TB 24323/4
98	RV10	3 kΩ, 1W, Linear.	TB 17359/5
99	RV11	15 kΩ, 1W, Linear.	TB 13015/5
		THERMISTOR	
99/1	TH1	Mullard Type VA1034.	106-TM 5066/2

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS	
100	C2	Electrolytic, 8 μF +50% -20%, 450 V d.c.	PC 18406/2
101	C3	Electrolytic, 32 μF +50% -20%, 450 V d.c.	PC 18407/1
102	C4	Paper, 0.25 μF ±25%, 350 V d.c.	PC 19303/3
103	C5	Ceramic, 1 μμF ±0.5 μμF, 500 V d.c.	PC 18201/1
104	C6	Special, 27 μμF.	TE 23106/10
105	C7	Special, 27 μμF.	TE 23106/10
106	C8	Paper, 0.01 μF ±20%, 400 V d.c.	37-TM 5066/1
107	C9	Paper, 0.015 μF*, 350 V d.c.	8-TM 1296F
108		Variable, Special Split-Stator, Air, 50 μμF; includes rotor vanes, five sets of stator vanes, and insulated mounting plates. Included in Item 109.	
109		R.F. Tuned Circuit Assembly; comprises Items 108 and 159 to 163.	TM 5065
110	C11	Ceramic, 1.5 μμF ±0.5 μμF, 500 V d.c.	PC 18201/2
111	C12	Ceramic, 1 μμF ±0.5 μμF, 500 V d.c.	PC 18201/1
112	C13	Ceramic, 47 μμF ±10%, 500 V d.c.	20-TM 4819/1
113	C14	Special, 200 μμF.	
114	C15	Electrolytic, 8 μF +50% -20%, 450 V d.c.	PC 18406/2
115	C16	Paper, 0.25 μF ±25%, 350 V d.c.	PC 19303/3

* Nominal value; actual value determined during calibration.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS (continued)	
116	C17	Paper, 0.05 µF ±25%, 250 V d.c.	PC 19302/1
117	C18	Paper, 0.05 µF ±25%, 250 V d.c.	PC 19302/1
118	C19	Paper, 6 µF ±20%, 150 V d.c.	39-TM 5066/1
119	C20	Electrolytic 8 µF +50% -20%, 450 V d.c.	PC 18406/2
120	C21	Electrolytic 25 µF +100% -20%, 25 V d.c.	PC 18402/15
121	C22	Paper, 0.1 µF ±20%, 350 V d.c.	PC 19202/14
122	C24	Paper, 0.5 µF ±20%, 500 V d.c.	PC 19203/23
123	C25	Electrolytic, 8 µF +50% -20%, 450 V d.c.	PC 18406/2
124	C26	Electrolytic, 8 µF +50% -20%, 450 V d.c.	PC 18406/2
125	C27	Paper, 1 µF ±25%, 150 V d.c.	PC 19301/4
126	C28	Feed Through, 4700 µµF, 500 V d.c., included in Item 177.	5-TM 4883
127	C29	Feed Through, 4700 µµF, 500 V d.c., included in Item 177.	6-TM 4883
128	C30	Feed Through, 4700 µµF, 500 V d.c., included in Item 177.	6-TM 4883
129	C31	Feed Through, 200 µµF, 500 V d.c., included in Item 178.	5-TM 4883D
130	C32	Feed Through, 200 µµF, 500 V d.c., included in Item 178.	6-TM 4883D
131	C33	Feed Through, 200 µµF, 500 V d.c., included in Item 178.	6-TM 4883D

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS (continued)	
132	C34	Feed Through, 4700 µµF, 500 V d.c., included in Item 179.	5-TM 4883E
133	C35	Feed Through, 4700 µµF, 500 V d.c., included in Item 179.	6-TM 4883E
134	C36	Feed Through, 4700 µµF, 500 V d.c., included in Item 179.	6-TM 4883E
135	C37	Feed Through, 4700 µµF, 500 V d.c., included in Item 180.	5-TM 4883E
136	C38	Feed Through, 4700 µµF, 500 V d.c., included in Item 180.	6-TM 4883E
137	C39	Feed Through, 4700 µµF, 500 V d.c., included in Item 180.	6-TM 4883E
138	C40	Feed Through, 200 µµF, 500 V d.c., included in Item 181.	5-TM 4883D
139	C41	Feed Through, 200 µµF, 500 V d.c., included in Item 181.	6-TM 4883D
140	C42	Feed Through, 200 µµF, 500 V d.c., included in Item 181.	6-TM 4883D
141a	C43	Feed Through, 500 µµF, 500 V d.c., included in Item 182.	5-TM 4883F
142a	C44	Feed Through, 500 µµF, 500 V d.c., included in Item 182.	6-TM 4883F
143a	C45	Feed Through, 500 µµF, 500 V d.c., included in Item 182.	6-TM 4883F
144	C46	Paper, 0.005 µF*, 400 V d.c.	33-TM 5066/1

* Nominal value; actual value determined during calibration.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS (continued)	
145	C47	Paper, 0.05 µF ±20%, 500 V d.c.	PC 19203/17
146	C48	Ceramic, 500 µµF*, 350 V d.c.	9-TM 1296F
147	C49	Electrolytic, 8 µF +50% -20%, 450 V d.c.	PC 18406/2
148	C50	Paper, 0.002 µF ±20%, 400 V d.c.	47-TM 5066/1
149	C51	Electrolytic, 8 µF +50% -20%, 450 V d.c.	PC 18406/2
150	C52	Paper, 0.005 µF ±20%, 150 V d.c.	102-TM 5066/1
151	C53	Paper, 0.005 µF ±20%, 150 V d.c.	102-TM 5066/1
151/1	C54	Air, Preset, 0.5 to 3 µµF.	24-TM 5067
		TRANSFORMERS AND INDUCTORS	
152	T1	Mains Transformer.	TM 5305
153	T2	Tuned Modulation Transformer.	TM 1296F
154	L1	H.F. Inductor.	TD 16363/44
155	L2	Bifilar Inductor.	TB 24630/1
156	L4	Attenuator Pick-up Inductor.	TB 23155/1
157	L5	Monitor Pick-up Inductor.	TD 24628/5
158	L6	H.T. Smoothing Inductor.	TM 5172/7

* Nominal value; actual value determined during calibration.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		TRANSFORMERS AND INDUCTORS (continued)	
159	L7	Oscillator Inductor Assembly, Band A; included in Item 109.	TM 4882J
160	L8	Oscillator Inductor Assembly, Band B; included in Item 109.	TM 4882K
161	L9	Oscillator Inductor Assembly, Band C; included in Item 109.	TM 4882L
162	L10	Oscillator Inductor Band D; included in Item 109.	TD 24607/3
163	L11	Oscillator Inductor Band E; included in Item 109.	5-TM 5065
164	L12	R.F. Inductor 95 μH; included in Item 177.	TB 23173/12
165	L13	R.F. Inductor 95 μH; included in Item 177.	TB 23173/12
166	L14	R.F. Inductor 95 μH; included in Item 178.	TB 23173/12
167	L15	R.F. Inductor 95 μH; included in Item 178.	TB 23173/12
168	L16	R.F. Inductor 6 μH; included in Item 179.	TB 23173/6
169	L17	R.F. Inductor 6 μH; included in Item 179.	TB 23173/6
170	L18	R.F. Inductor 6 μH; included in Item 180.	TB 23173/6
171	L19	R.F. Inductor 6 μH; included in Item 180.	TB 23173/6
172	L20	R.F. Inductor 95 μH; included in Item 181.	TB 23173/12
173	L21	R.F. Inductor 95 μH; included in Item 181.	TB 23173/12
174	L22	R.F. Inductor 95 μH; included in Item 182.	TB 23173/12
175	L23	R.F. Inductor 95 μH; included in Item 182.	TB 23173/12
176	L24	L.F. Inductor 250 mH.	TM 5662

SOS Item No.	Circuit Ref.	Description	Works Ref.
		R.F. FILTER UNITS	
177		Filter Unit, H.T. V2; includes Items 126, 127, 128, 164, and 165.	TM 4883
178		Filter Unit, A.F. INPUT; includes Items 129, 130, 131, 166, and 167.	TM 4883D
179		Filter Unit, L.T.; includes Items 132, 133, 134, 168, and 169.	TM 4883E
180		Filter Unit, L.T.; includes Items 135, 136, 137, 170, and 171.	TM 4883E
181		Filter Unit, H.T. V6; includes Items 138, 139, 140, 172, and 173.	TM 4883D
182		Filter Unit, MONITOR; includes Items 141, 142, 143, 174, and 175.	TM 4883F
		FERRITE MODULATOR	
183	TR1	Modulator Unit.	TM 5000/1
		VALVES, HOLDERS, AND RETAINERS	
184	V1	Full-Wave Rectifier, Type 5Z4G.	73-TF 1066
185		Holder for V1, International Octal.	PC 81814/1
186		Retainer for V1.	TC 22744/12

SOS Item No.	Circuit Ref.	Description	Works Ref.
		VALVES, HOLDERS, AND RETAINERS (continued)	
187	V2	Pentode, Type 6AK6.	83-TM 5067
188		Holder for V2, B7G with Skirt.	TB 26904/2
189		Screening Can for V2.	PC 17501/2
190	V3	Power Tetrode, Type 6CD6G.	76-TF 1066
191		Holder for V3, International Octal.	PC 81814/1
192		Retainer for V3.	TC 22744/57
193	V4	Pentode, Type 6AK5.	74-TF 1066
194		Holder for V4, B7G with Skirt.	TB 26904/2
195		Screening Can for V4.	PC 17501/1
196	V5	Stabilizer, Type 85A2.	114-TF 1066
197		Holder for V5, B7G with Skirt.	TB 26904/2
198		Screening Can for V5.	PC 17501/3
199	V6	Disc-Seal Triode, Type DET 22.	84-TM 5067
200		Connecting Straps for V6.	TE 17593/8A
201		Cathode/Heater Socket for V6.	46/51-TM 5067
202	V7	Triode, Type 6C4.	79-TF 1066
203		Holder for V7, B7G with Skirt.	TB 26904/2
204		Screening Can for V7.	PC 17501/2

SCS Item No.	Circuit Ref.	Description	Works Ref.
		VALVES, HOLDERS, AND RETAINERS (continued)	
205	V8	Tetrode, Type 6L6G.	75-TF 1066
206		Holder for V8, International Octal.	PC 81814/1
207		Retainer for V8.	TC 22744/57
208	V9	Double Triode, Type 12AX7.	80-TF 1066A
209		Holder for V9, B9A with Skirt.	TB 26905/2
210		Screening Can for V9.	PC 17502/2
211	V10	Stabilizer, Type OB2.	77-TF 1066
212		Holder for V10, B7G with Skirt.	TB 26904/2
213		Screening Can for V10.	PC 17501/3
214	V11	Barretter, Type XB1.	78-TF 1066A
215		Holder for V11, B7G with Skirt.	TB 26904/2
216		Screening Can for V11.	PC 17501/2
217	V12	Barretter, Type XB1.	78-TF 1066A
218		Holder for V12, B7G with Skirt.	TB 26904/2
219		Screening Can for V12.	PC 17501/2

SOS Item No.	Circuit Ref.	Description	Works Ref.
		METAL RECTIFIERS AND CRYSTAL DIODES	
220	MR1	Metal Rectifier S.T.C. Type D18-13-1B2Z.	70-TM 5066/1
221	MR2	Silicon Crystal Diode, CS2A.	25-TM 5067
222	MR3	Germanium Crystal Diode, CG1E.	45-TM 5066/1
223	MR4	Germanium Crystal Diode, CG1E.	45-TM 5066/1
		LAMP AND HOLDER	
224	PLP1	Pilot Lamp, 6.3-volt, 0.15-amp, M.B.C.	87-TF 1066
225		Holder for PLP1.	TB 25073/2
		FUSES AND HOLDERS	
226	FS1	2.0-amp Cartridge Fuse.	89-TF 1066
227		Holder for FS1.	TB 24330/1
228	FS2	2.0-amp Cartridge Fuse.	89-TF 1066
229		Holder for FS2.	TB 24330/1
230	FS3	0.25-amp Cartridge Fuse.	88-TF 1066
231		Holder for FS3.	TB 24330/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		METERS	
232	M1	Carrier Level Meter, 100 μA f.s.d.	TM 3970/53
233	M2	Modulation Meter, 100 μA f.s.d.	TM 3970/52
		PLUGS, SOCKETS, TERMINALS, AND CONNECTING LEADS	
234		Mains Lead, 6-ft, complete with 3-pin plug, Item 235, and Grommet-Sleeve, (British Fitting.)	TM 2560AU
235	PL1	Plug, 3-pin, 5-amp; included in Item 234.	1-TM 2560AU
236		Mains Lead, comprising 6-ft flexible cable, 2-pin plug, and Grommet-Sleeve. (American Fitting.)	TM 2560AX
237	SKT1	Socket, coaxial Type N, 50 Ω.	15-TM 4819/1
238		Plug, coaxial Type N, 50 Ω; to fit Item 237.	115-TF 1066
239		Screw terminals, set of three, for FM, AM, and Earth.	TB 24330/5
240		Coaxial Connector, 50 Ω, 3-ft long; Type N plug both ends.	TM 4824
241		Attenuator Pad, 6 dB, 50 Ω; one end, Type N socket; other end, Type N plug.	TM 4919/1
242		Attenuator Pad, 20 dB, 50 Ω; one end, Type N socket; other end, Type N plug.	TM 4919
243		Matching Unit, 50 Ω to 75 Ω; one end, Type N socket; other end, Belling-Lee L734/P plug.	TM 4918

SOS Item No.	Circuit Ref.	Description	Works Ref.
		PLUGS, SOCKETS, TERMINALS, AND CONNECTING LEADS (continued)	
244		Matching Unit, 50 Ω unbalanced to 300 Ω balanced; one end, Type N socket; other end, solder tags.	TM 4916
245		D.C. Isolating Unit; one end, Type N socket; other end, crocodile clips.	TM 4917
		SWITCHES	
246	S A	Toggle, 2 position, 2 pole.	TB 23903/2
247	S B	Rotary, 5 position, 3 wafer, 5 pole.	TC 4428/432
248	S C	Rotary, 6 position, 4 wafer, 4 pole.	TC 4428/390
249	S D	Rotary, 4 position, 2 wafer, 1 pole.	TC 4428/391
250	S E	Toggle, 2 position, 2 pole.	TB 23903/2
251	S F	Rotary, 8 position, 3 wafer, 3 pole, included in Item 252.	TC 4428/431
252		INC. FREQ. Switch Assembly; includes Items 3, 60 to 67, and 251.	TM 5279
		KNOBS, DRIVES, AND DIALS	
253		Knob, for FREQUENCY control, complete with handle, washer, and handle-securing screw.	TD 23123/2A TD 23123/5 TB 6775/4 TD 23172/3

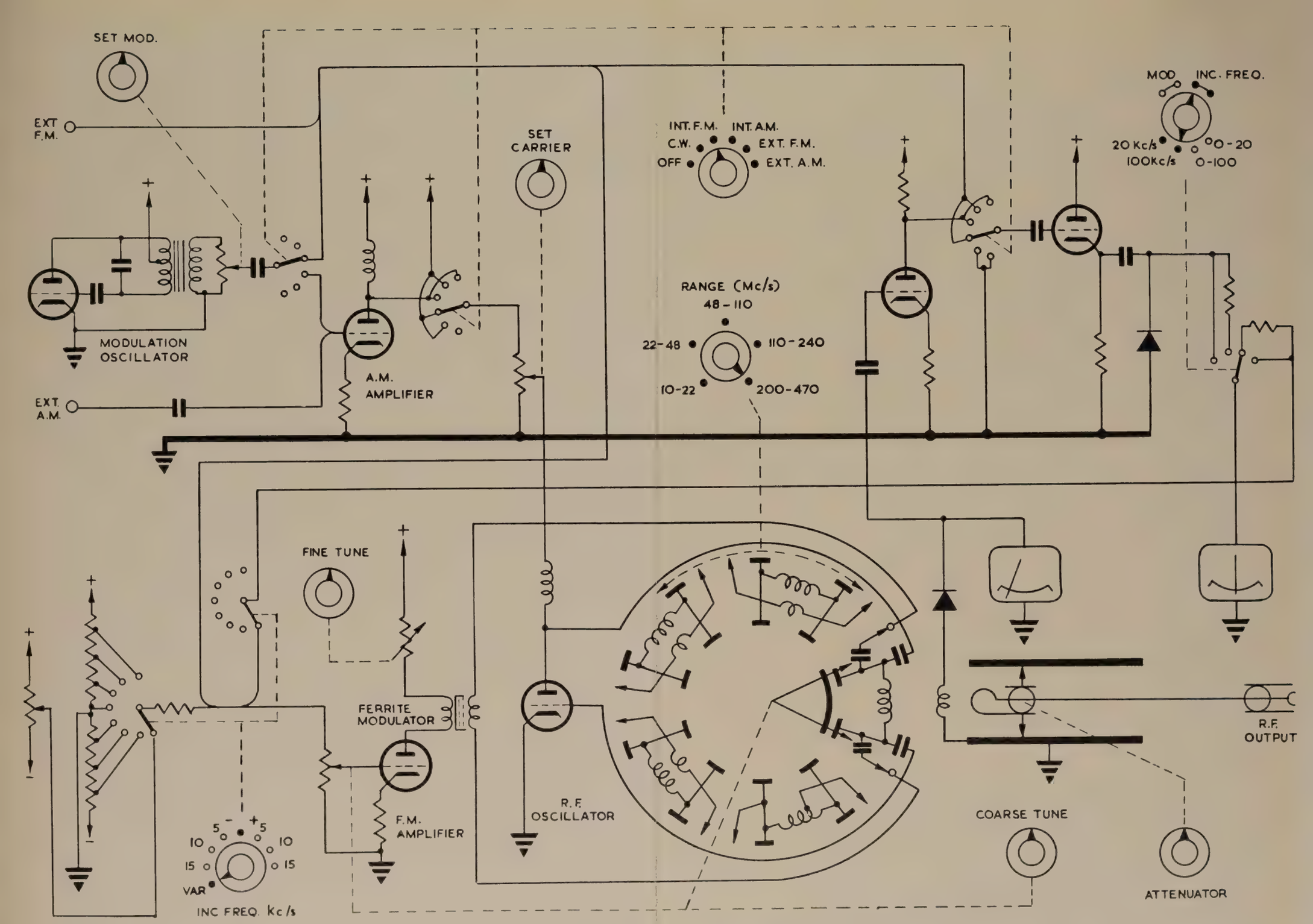
SCS Item No.	Circuit Ref.	Description	Works Ref.
		KNOBS, DRIVES, AND DIALS (continued)	
254		Knob, for RANGE switch.	TB 3969/3
255		Knob, for HUM ADJUST control.	TB 23920/2
256		Knob, for FINE TUNE control.	TB 23920/2
257		Knob, for SET CARRIER control.	TB 17848/3
258		Knob, for MODULATION switch.	TB 3969/3
259		Knob, for ATTENUATOR control.	TB 17848/4
260		Knob, for SET MODULATION control.	TB 17848/3
261		Knob, for MOD./INC. FREQ. switch.	TB 17848/5
262		Knob, for INC. FREQ. switch.	TB 17848/3
263		Knob, for variable INC. FREQ. control.	TB 23920/2
264		Frequency Dial and Dial Housing Assembly; comprises Items 265 to 271.	
265		Frequency Dial, uncalibrated; included in Item 264.	TC 24621
266		Frequency Dial Housing; included in Item 264.	TD 24619
267		Perspex Window Moulding; included in Item 264.	TC 18378/1
268		Centre Disc; fits between Item 267 and washer of Item 269; included in Item 264.	TC 23983/1
269		Captive Screw and Washer; for attaching Item 267 to Item 280; included in Item 264.	TE 18339/14 TE 18339/15

SOS Item No.	Circuit Ref.	Description	Works Ref.
		KNOBS, DRIVES, AND DIALS (continued)	
270		Helical Spring; fits behind Item 268; included in Item 264.	TB 25849
271		Perspex Cursor; included in Item 264.	TB 25128
272		Frequency Drive Slow-Motion and Gear Assembly; includes Items 273 to 281.	
273		Reduction Gear Unit; operated by means of Item 253; included in Item 272.	TC 24616
274		Gearwheel and Bellows Coupling; connected to spindle of Item 108, and engages with Items 273 and 275; included in Item 272.	TD 24629/2
275		Gear Wheel; interposed between Items 274 and 278 and mounted on Item 276, carries Item 90; included in Item 272.	TE 24620/1B
276		Pivot Arm,Spindle and Locking Collar; carries Items 90 and 275 and is secured to Item 281; included in Item 272.	TE 24620/4 TB 22816/1
277		Tension Spring; maintains Item 275 in mesh with Items 274 and 278; included in Item 272.	TB 15342/20
278		Gearwheel; engages with Item 275 and carries Items 279, 280, and 265; included in Item 272.	TE 24620/1A
279		Spindle; interposed between Items 278 and 280; included in Item 272.	TB 22881/2
280		Boss and Support Spindle Assembly; boss secures to Item 279 and carries Item 265, spindle supports Item 271 and engages with Item 269; included in Item 272.	TE 23099/8 TE 23099/9 TB 16022/7

SOS Item No.	Circuit Ref.	Description	Works Ref.
		KNOBS, DRIVES, AND DIALS (continued)	
281		Bush and Nut; secured to Item 282 and carries spindle of Item 276; included in Item 272.	TB 14790/28 TB 15245/32
282		Support Plate; mounted on r.f. unit support castings and carries Item 278.	TE 24620/5
283		U-Bracket; secured to Item 282 and supports Item 266.	TE 24620/14
284		Attenuator Dial and Dial Housing Assembly; comprises Items 285 to 291.	
285		Attenuator Dial, calibrated; included in Item 284.	TC 24631
286		Attenuator Dial Housing; included in Item 284.	TC 24622
287		Perspex Window Moulding; included in Item 284.	TC 25848/1
288		Centre Disc; fits between Item 287 and washer of Item 289; included in Item 284.	TC 23983/2
289		Captive Screw and Washer; for attaching Item 287 to Item 299; included in Item 284.	TE 18339/14 TE 18339/15
290		Helical Spring; fits behind Item 288; included in Item 284.	TB 25849
291		Perspex Cursor; included in Item 284.	TB 25854
292		Attenuator Drive and Slow-Motion Assembly; comprises Items 293 to 301.	

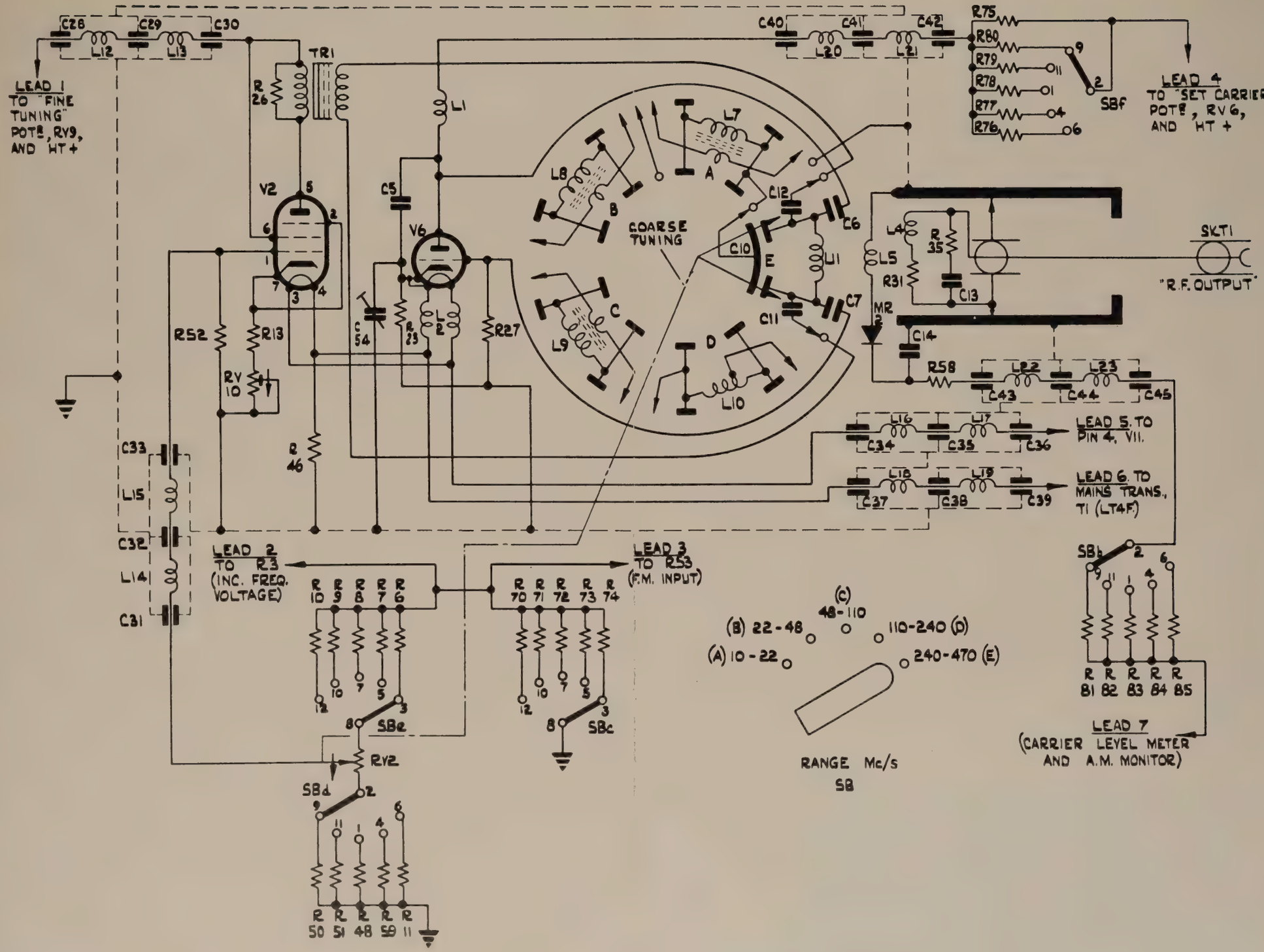
SOS Item No.	Circuit Ref.	Description	Works Ref.
		KNOBS, DRIVES, AND DIALS (continued)	
293		Control Spindle; operated by means of Item 259; included in Item 292.	TE 25340/13C
294		Bush and Nut; holds Item 293 to Item 302; included in Item 292.	TE 24620/15 TB 15245/32
295		Driving Disc and Bush; secured to Item 293 and engages with Item 296; included in Item 292.	TB 26857/3
296		Jockey Wheel Assembly comprising two Wheels, two Washers, and Loop Spring; interposed between Items 295 and 297; included in Item 292.	TE 24620/11 TC 20027/1 TB 25001/2/P23
297		Driving Disc and Bush; engages with Item 296 and is mounted on Item 298; included in Item 292.	TB 26857/8
298		Spindle; interposed between Items 297 and 299, carries Item 301; included in Item 292.	TB 22881/11
299		Boss and Support Spindle Assembly; boss secures to Item 298 and carries Item 285, spindle supports Item 291 and engages with Item 289; included in Item 292.	TE 23099/8 TE 23099/9 TB 16022/7
300		Bush and Nut; holds Item 298 to plate mounted behind Item 286; included in Item 292.	TE 24620/13 TB 15245/32
301		Bellows Coupling; couples Item 298 to drive spindle of piston attenuator assembly; included in Item 292.	TD 24618/3

SOS Item No.	Circuit Ref.	Description	Works Ref.
		MISCELLANEOUS	
302		Front Panel.	TE 27668
303		Front Panel Surround and Rubber Fillet.	TB 23984 TE 23103/1
304		Instrument Case, main section, complete with side pockets but excluding Items 305 and 306.	TD 25872
305		Case Feet, set of eight, to fit Item 304.	TA 11420
306		Carrying Handles, set of two, to fit Item 304.	TB 18258/2
307		Anodized Edging Strip, to fit between Items 303 and 304.	TD 23713/3
308		Cover Plate, gives access to Mains Tapping Panel.	TE 23106/2A
309		Hexagonal Wrenches, set of three, for socket set-screws size 2-, 4-, and 6-BA; complete in linen bag.	102-TF 1066
310		Chart, blank, for Deviation and Incremental Frequency Monitor; complete with plastic bag.	TC 25688 TC 23320/6
311		Operating and Maintenance Handbook.	OM 1066A



FUNCTIONAL DIAGRAM

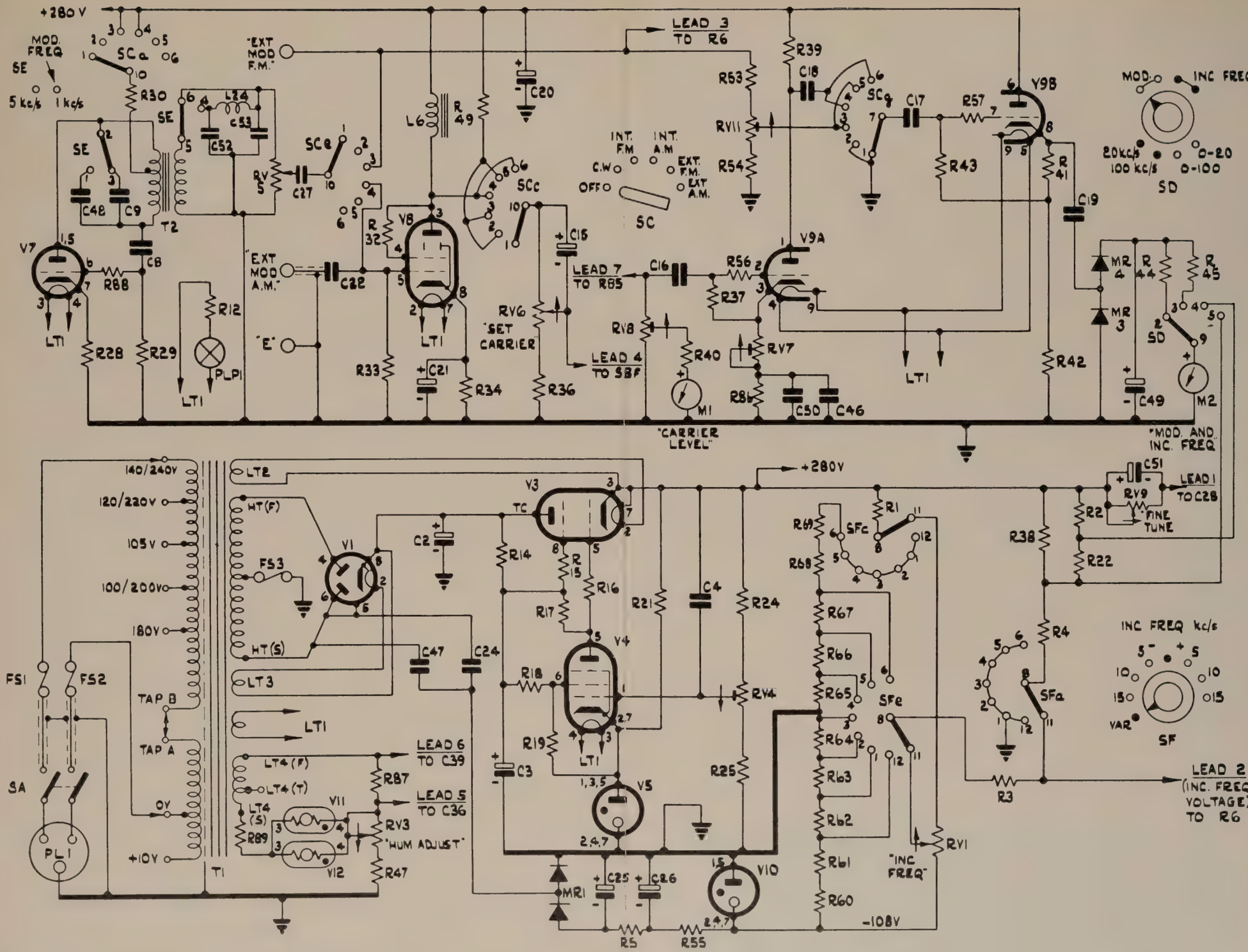
TLC 28312



Lead 1, Lead 2, etc. are connections to L.F. and Power unit (see TLC 28314)

CIRCUIT DIAGRAM

RF UNIT



Lead 1, Lead 2, etc. are connections to R.F. unit (see TLC 28313)

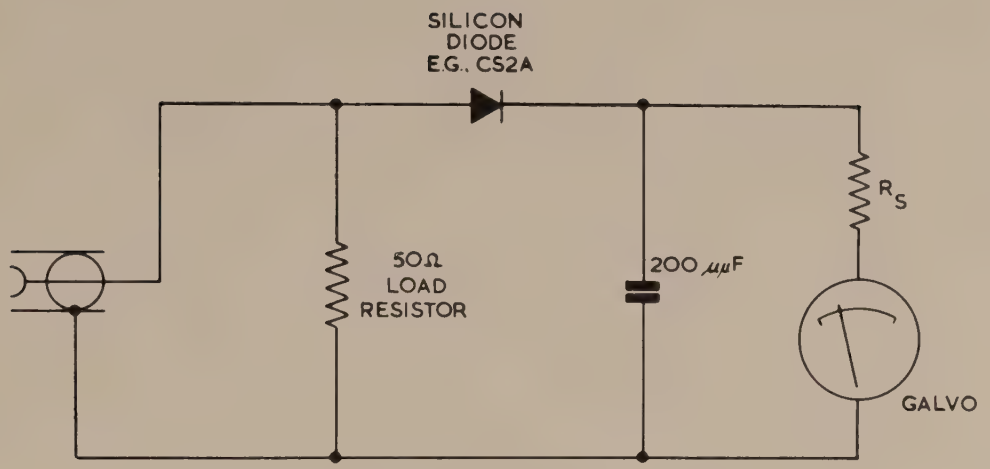
Thermistor TH1 is connected between pin 3 of V11 (and V12) and R89

CIRCUIT DIAGRAM

LF AND POWER UNIT

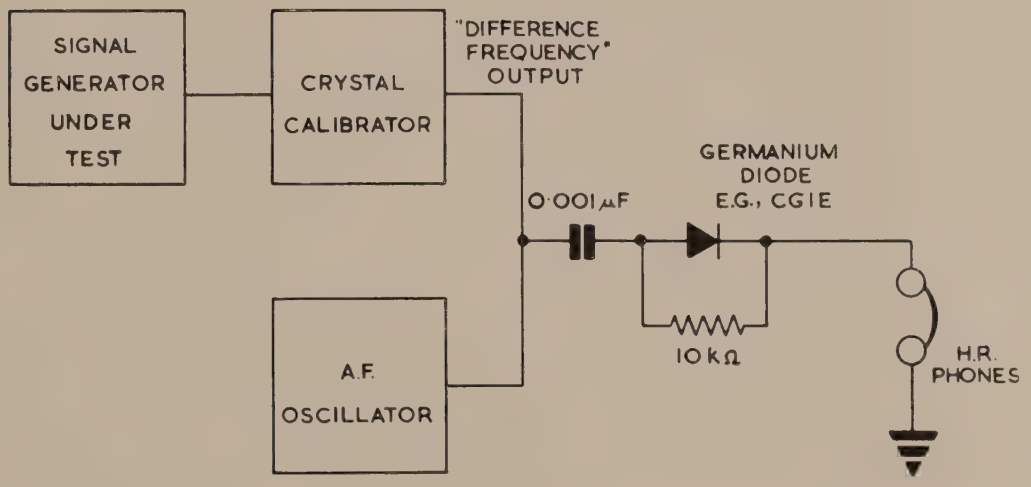
TLC 28314

C.P. 4c. 4/60



NOTE: FOR OPTIMUM WORKING, TOTAL RESISTANCE OF GALVO. AND R_S SHOULD BE ABOUT 8kΩ

50–OHM DIODE VOLTMETER



INC. FREQ. TEST CIRCUIT

M.I. LTD. TF 1066A —1/558

TEST CIRCUITS

DECIBEL CONVERSION TABLE

Ratio Down			*Ratio Up*	
VOLTAGE	*POWER*	*DECIBELS*	*VOLTAGE*	*POWER*
1·0	1·0	**0**	1·0	1·0
·9886	·9772	**·1**	1·012	1·023
·9772	·9550	**·2**	1·023	1·047
·9661	·9333	**·3**	1·035	1·072
·9550	·9120	**·4**	1·047	1·096
·9441	·8913	**·5**	1·059	1·122
·9333	·8710	**·6**	1·072	1·148
·9226	·8511	**·7**	1·084	1·175
·9120	·8318	**·8**	1·096	1·202
·9016	·8128	**·9**	1·109	1·230
·8913	·7943	**1·0**	1·112	1·259
·8710	·7586	**1·2**	1·148	1·318
·8511	·7244	**1·4**	1·175	1·380
·8318	·6918	**1·6**	1·202	1·445
·8128	·6607	**1·8**	1·230	1·514
·7943	·6310	**2·0**	1·259	1·585
·7762	·6026	**2·2**	1·288	1·660
·7586	·5754	**2·4**	1·318	1·738
·7413	·5495	**2·6**	1·349	1·820
·7244	·5248	**2·8**	1·380	1·905
·7079	·5012	**3·0**	1·413	1·995
·6683	·4467	**3·5**	1·496	2·239
·6310	·3981	**4·0**	1·585	2·512
·5957	·3548	**4·5**	1·679	2·818
·5623	·3162	**5·0**	1·778	3·162
·5309	·2818	**5·5**	1·884	3·548
·5012	·2512	**6**	1·995	3·981
·4467	·1995	**7**	2·239	5·012
·3981	·1585	**8**	2·512	6·310
·3548	·1259	**9**	2·818	7·943
·3162	·1000	**10**	3·162	10·000
·2818	·07943	**11**	3·548	12·59
·2512	·06310	**12**	3·981	15·85
·2239	·05012	**13**	4·467	19·95
·1995	·03981	**14**	5·012	25·12
·1778	·03162	**15**	5·623	31·62

DECIBEL CONVERSION TABLE

Ratio Down			*Ratio Up*	
VOLTAGE	*POWER*	*DECIBELS*	*VOLTAGE*	*POWER*
·1585	·02512	**16**	6·310	39·81
·1413	·01995	**17**	7·079	50·12
·1259	·01585	**18**	7·943	63·10
·1122	·01259	**19**	8·913	79·43
·1000	·01000	**20**	10·000	100·00
·07943	·006310	**22**	12·59	158·5
·06310	·003981	**24**	15·85	251·2
·05012	·002512	**26**	19·95	398·1
·03981	·001585	**28**	25·12	631·0
·03162	·001000	**30**	31·62	1,000
·02512	·0006310	**32**	39·81	1,585
·01995	·0003981	**34**	50·12	2,512
·01585	·0002512	**36**	63·10	3,981
·01259	·0001585	**38**	79·43	6,310
·01000	·0001000	**40**	100·00	10,000
·007943	·00006310	**42**	125·9	15,850
·006310	·00003981	**44**	158·5	25,120
·005012	·00002512	**46**	199·5	39,810
·003981	·00001585	**48**	251·2	63,100
·003162	·00001000	**50**	316·2	100,000
·002512	$6{\cdot}320 \times 10^{-6}$	**52**	398·1	158,500
·001995	$3{\cdot}981 \times 10^{-6}$	**54**	501·2	251,200
·001585	$2{\cdot}512 \times 10^{-6}$	**56**	631·0	398,100
·001259	$1{\cdot}585 \times 10^{-6}$	**58**	794·3	631,000
·001000	10^{-6}	**60**	1,000	10^{6}
·0005623	$3{\cdot}162 \times 10^{-7}$	**65**	1,778	$3{\cdot}162 \times 10^{6}$
·0003162	10^{-7}	**70**	3,162	10^{7}
·0001778	$3{\cdot}162 \times 10^{-8}$	**75**	5,623	$3{\cdot}162 \times 10^{7}$
·0001000	10^{-8}	**80**	10,000	10^{8}
·00005623	$3{\cdot}162 \times 10^{-9}$	**85**	17,780	$3{\cdot}162 \times 10^{8}$
·00003162	10^{-9}	**90**	31,620	10^{9}
·00001000	10^{-10}	**100**	100,000	10^{10}
$3{\cdot}162 \times 10^{-6}$	10^{-11}	**110**	316,200	10^{11}
10^{-6}	10^{-12}	**120**	10^{6}	10^{12}
$3{\cdot}162 \times 10^{-7}$	10^{-13}	**130**	$3{\cdot}162 \times 10^{6}$	10^{13}
10^{-7}	10^{-14}	**140**	10^{7}	10^{14}

MP MASTER
MA31183